LIBRARY

ORDNANCE

★ ★

THE MAGAZINE OF SCIENTIFIC AND INDUSTRIAL PREPAREDNESS

VOL. XXXII, No. 167 MARCH-APRIL, 1948

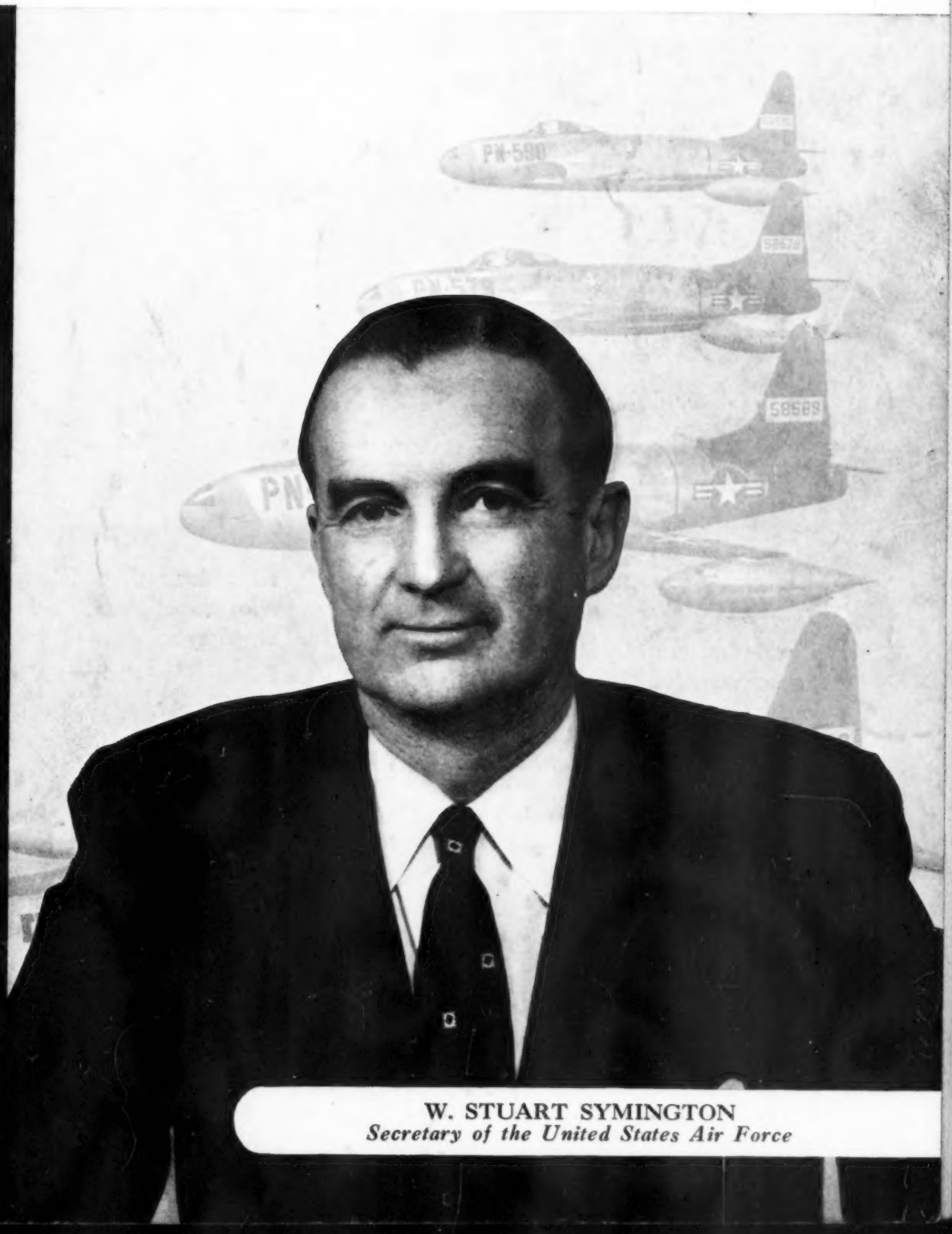
FOUNDED 1920

★

IN THIS ISSUE

★

THE JOURNAL OF THE AMERICAN ORDNANCE ASSOCIATION WASHINGTON, D. C.



W. STUART SYMINGTON
Secretary of the United States Air Force

Take a Tip on Gears

...from this new

Mack 10-SPEED TRANSMISSION

INCREASE LOAD CAPACITY

RAISE IMPACT STRENGTH

ADD WEAR-RESISTANCE

...with Nickel Alloy Steels

These gears demonstrate basic advantages secured by using Nickel alloy steels . . .

Steels that not only provide increased resistance to shock and high tooth pressure . . . but, in addition, are readily machinable and respond to heat treatment with minimum distortion.

Pinions, gears and shafts of the Nickel-molybdenum steels used in this transmission provide exceptionally hard carburized surfaces over strong, tough cores.

Types 4620 and 4820 steels are supplemented by the use of 4320 Nickel-chromium-molybdenum steel for some parts.

High load carrying capacity, and the consistently long, dependable performance of Nickel alloy steels in heavy-duty service, make their economy self-evident. Improve your products or equipment by specifying vital parts in Nickel alloy steels.

EMBLEM OF INCO SERVICE
TRADE MARK

Over the years, International Nickel has accumulated a fund of useful information on the selection, fabrication, treatment and performance of engineering alloy steels, stainless steels, cast irons, copper-base and other alloys containing Nickel. This information is yours for the asking. Write for "List A" of available publications.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N.Y.

Founded 1920

ORDNANCE

Combined with Logistics

THE JOURNAL OF THE AMERICAN ORDNANCE ASSOCIATION

FEATURES

For Peace . . . . . Frontispiece
American Air Power 305
Our Vanishing Airmada 306
JOHN A. GILES
Science and the Soldier 309
MAJ. GEN. J. F. C. FULLER
Industry Underground 313
IRA W. MACBRIDE
The New Navy 316
EDWARD J. EVANS
Bombs versus German Industry 318
LEO A. CODD
The Coast Guard (Pictorial) 321
Danger—Live Ammo! 325
LIEUT. THOMAS A. MORT
Industry-Ordnance Leaders 326
Rockets in History 327
F. W. F. GLEASON
New Jet Aircraft (Pictorial) 330
Month by Month 331
Essential Ingredient 333
JAMES L. WALSH

DEPARTMENTS

New Developments . . . 294
Association Affairs . . . 334
The National Divisions, A.O.A. 336
Honor Roll of Industrial Preparedness 337
Atomic Energy 341
Guided Missiles 342
Book Reviews 346
Index of Advertisements . 355

Vol. XXXII MARCH-APRIL, 1948 No. 167

ORDNANCE is published bimonthly by the American Ordnance Association, 705 Mills Building, Washington 6, D. C. Entered as second-class matter, August 14, 1920, at the Post Office at Washington, D. C., under the Act of March 3, 1879. Additional second-class entry at the Post Office at Richmond, Va. Subscription rate: continental U. S. and possessions, $4.50 annually, in advance; foreign, $6.00. Copyright 1948 by the American Ordnance Association. Six weeks' notice before next publication date required for change of address.

Editor: Leo A. Codd. Managing Editor: R. E. Lewis. Editorial Staff: M. L. Van Horn, J. J. O'Connor, R. P. Hines.

ORDNANCE has no official or semiofficial governmental status. All statements expressed in the articles, editorials, and advertisements are those of the authors, editors, and advertisers and do not represent official governmental policy.

THE LONG-RANGE AIMS AND PURPOSES OF THE AMERICAN ORDNANCE ASSOCIATION

1. Adequate national security. This is the great goal of peace. It is best obtained through a nonpartisan and persistent national policy which will ensure that the amount of military power—ground, sea, and air—available to this country and its probable friends will never be less than that available to its probable enemies.

2. Adequate munitions power. This is one of the two basic foundations of military power. The amount of it in quality and quantity available to the United States and its probable friends for timely and effective use should never be less than that available to its probable enemies.

3. Adequate military man power. This is the other main foundation of military power. The amount of it available to the United States and its probable friends should likewise never be less than that required for the timely and effective utilization of the munitions power essential to victory.

4. An ideal basis for achieving adequate munitions power. Existing stocks of munitions plus expected production should equal requirements both in quantity and quality at all times. Consequently, the more the United States can depend upon and speed up the mobilization rate of American industry, the smaller the stocks we have to maintain, the more up to date our munitions in time of conflict, and the less the cost.

5. To achieve the above objectives the following principles are advocated:

a. Designs of military armament that are second to none.

b. Existing stocks of combat and other munitions that are adequate in quantity and quality.

c. Efficient and dependable industrial mobilization with maximum shortening of the time factors involved, including the political time factor, the administrative time factor, and the industrial time factor.

d. Current and constant education, training, and development of the military-science-industry team.

—*The Editors*

NATIONAL AND REGIONAL OFFICIALS AND

Officers.—President: James L. Walsh, New York, N. Y. Vice-Presidents: Herbert A. Gidney, Pittsburgh, Pa.; Harvey C. Knowles, Cincinnati, Ohio. Treasurer: Henry P. Erwin, Washington, D. C. Counsel: John Ross Delafield, New York, N. Y.

Directors.—W. W. Coleman, Milwaukee, Wis.; Benedict Crowell, Cleveland, Ohio; Henry P. Erwin, Washington, D.C.; H. A. Gidney, Pittsburgh, Pa.; R. E. Gillmor, New York, N. Y.; C. J. Ingersoll, Philadelphia, Pa.; K. T. Keller, Detroit, Mich.; H. C. Knowles, Cincinnati, Ohio; R. P. Lamont, New York, N. Y.; F. H. Payne, Springfield, Mass.; F. A. Scott, Cleveland, Ohio; John Slezak, Sycamore, Ill.; J. L. Walsh, New York, N. Y.; C. D. Wiman, Moline, Ill.

Advisory Board.—H. W. Alden, Detroit, Mich.; J. D. Biggers, Toledo, Ohio; G. W. Elliott, Philadelphia, Pa.; R. E. Gardner, Jr., St. Louis, Mo.; Earl B. Gilmore, Los Angeles, Calif.; T. M. Girdler, Cleveland, Ohio; A. W. Herrington, Indianapolis, Ind.; B. T. McNeil, Houston, Tex.; T. A. Morgan, New York, N. Y.; S. E. Reimel, New York, N. Y.; C. H. Tenney, Springfield, Mass.; J. W. Wadsworth, Geneseo, N. Y.; C. E. Wilson, New York, N. Y.

Council.—H. W. Alden, Detroit, Mich.; C. D. Ammon, Lincoln, Nebr.; A. J. Armstrong, Fort Worth, Tex.; F. B. Bell, Pittsburgh, Pa.; H. A. Bullis, Minneapolis, Minn.; J. H. Burns, Washington, D. C.; W. M. Canaday, Toledo, Ohio; W. W. Coleman, Milwaukee, Wis.; Benedict Crowell, Cleveland, Ohio; Harry Darby, Kansas City, Kans.; C. K. Davis, Bridgeport, Conn.; A. G. Drefs, St. Louis, Mo.; C. W. Dupuis, Cincinnati, Ohio; E. B. Gallaher, Norwalk, Conn.; H. A. Gidney, Pittsburgh, Pa.; R. E. Gillmor, New York, N. Y.; R. F. Gow, Worcester, Mass.; E. T. Gusheé, Detroit, Mich.; T. S. Hammond, Chicago, Ill.; J. M. Hancock, New York, N.Y.; Arnold Hanger, New York, N. Y.; F. D. Hansen, Milwaukee, Wis.; F. J. Hinderliter, Tulsa, Okla.; S. C. Hope, Springfield, Mass.; C. J. Ingersoll, Philadelphia, Pa.; J. E. Kanaley, Chicago, Ill.; W. S. Knudsen, Detroit, Mich.; R. P. Lamont, New York, N. Y.; F. B. Lee, Seattle, Wash.; Samuel McRoberts, New York, N. Y.; E. B. Meissner, St. Louis, Mo.; E. F. Norelius, Springfield, Ill.; K. T. Norris, Los Angeles, Calif.; L. S. Oakes, Minneapolis, Minn.; Walter Pew, Philadelphia, Pa.; F. A. Scott, Cleveland, Ohio; R. C. Scott, San Francisco, Calif.; F. J. Smith, Rochester, N. Y.; Ross Stewart, Houston, Tex.; H. M. Tillinghast, New York, N. Y.; J. E. Trainer, Akron, Ohio; J. L. Walsh, New York, N. Y.; T. J. Watson, New York, N. Y.; H. A. Winter, Denver, Colo.; Dean Witter, San Francisco, Calif.; S. H. Woods, Aberdeen Proving Ground, Md.

National Headquarters.—Executive Vice-President: Leo A. Codd. Secretary: F. G. Ferriter. Assistant Treasurer: M. F. Ferriter. Director National Activities Divisions: Burton O. Lewis. Book Service: J. J. O'Connor. Ordnance Professional Men's Service, T. L. Begun. Staff Assistants: G. C. Anderson, G. M. Crump, K. C. Hankey, M. D. Dzienkiewicz, E. M. Purks, M. J. Webb, N. A. Woodhouse.

THE OFFICERS, CHARTER DATES, AND HEADQUARTERS OF THE THIRTY CHAPTERS

Aberdeen Proving Ground, August 16, 1944

President: Charles McKnight. Vice-President: F. D. Dolan. Directors: T. F. Colleran, L. A. Delsasso, L. C. Josephs, J. S. B. Middleton, L. E. Nederkorn, T. E. Sterne. Treasurer: R. N. Mackin, III. Secretary: O. B. Brockmeyer, Jr., Aberdeen Proving Ground, Md.

Birmingham, December 3, 1930

President: Roy D. Hickman. Vice-President: T. M. Nesbitt, Jr. Directors: Hugh P. Bigler, Robert E. Gregg, T. E. Kilby, Jr., T. W. Martin, Merrill E. Pratt, R. J. Stockham, Oscar Wells. Treasurer: R. J. Stockham. Secretary: R. E. Parker, 700 Frank Nelson Building, Birmingham, Ala.

Central Illinois, May 29, 1945

President: L. P. Weiner. Vice-President: J. R. Munro. Directors: J. M. Barkman, S. S. Battles, M. C. Budlong, F. E. Martin, Emil Norelius, V. T. Wissen. Treasurer: Merle Yontz. Secretary: Robert Hafer, Peoria Association of Commerce, Peoria, Ill.

Chicago, May 3, 1924

President: John Slezak. Vice-President: H. J. Prebensen. Directors: E. J. Bush, W. E. Crocombe, Thomas Drever, T. S. Hammond, H. P. Isham, J. W. Karraker, James Knowlson, Fowler McCormick, F. W. Parker, Jr., W. G. Swartchild, Jr., W. R. Wright. Treasurer: G. D. Dearlove. Assistant Treasurer: G. R. Catlett. Secretary: M. J. Allen, Room 1410, 400 N. Michigan Avenue, Chicago 11, Ill.

Cincinnati, December 10, 1925

President: L. W. Scott Alter. Vice-Presidents: R. G. Calton, J. C. Shouvlin. Directors: R. K. Brodie, R. H. Ferger, F. V. Geier, E. R. Godfrey, E. A. Muller, Louis Polk, A. H. Pugh, Louis Ruthenburg. Secretary-Treasurer: C. H. Wood, Big Four Building, Cincinnati 2, Ohio.

Cleveland, October 25, 1940

President: Ward M. Canaday. 1st Vice-President: J. C. McHannan. Directors: R. F. Black, F. H. Chapin, F. C. Crawford, D. S. Ellis, William Forster, B. F. Hopkins, A. D. Joyce, Frank Purnell, H. A. Roemer, G. W. Stephens, W. R. Timken, J. E. Trainer, A. J. Weatherhead, Jr., C. M. White, Clyde Williams. Secretary-Treasurer: E. A. Lynn, 6200 Riverside Drive, Municipal Airport, Cleveland 30, Ohio.

Empire, April 29, 1938

President: F. J. Smith. Vice-Presidents: E. A. Halbleib, Keith Williams. Directors: G. W. Cole, C. F. Dietz, R. E. Dillon, J. E. Gleason, E. A. Halbleib, C. S. Hallauer, M. J. Hayes, F. F. Hickey, C. H. Lang, T. L. Lee, E. Norquist, F. J. Smith, D. W. Sowers, K. Williams. Treas.: E. R. Davenport. Acting Sect.: R. C. Hands, 1258 Sibley Tower Bldg., Rochester 4, N. Y.

Hartford-Springfield, November 18, 1941

President: S. C. Hope. Vice-Presidents: J. H. Chaplin, E. B. Gallaher, C. H. Granger. Directors: G. H. Anthony, M. K. Barroll, Jr., J. S. Begley, E. P. Bullard, J. H. Chaplin, F. U. Conard, C. K. Davis, E. B. Gallaher, W. M. Goss, C. H. Granger, S. C. Hope, L. E. Lentz, D. G. Millar, C. B. Parsons, F. H. Payne, H. H. Pease, R. E. Pritchard, E. S. Pugsley, J. Y. Scott, H. W. Steinkraus. Secretary-Treasurer: J. A. MacDonnell, Gilbert & Barker Mfg. Co., West Springfield, Mass.

Lehigh-Bethlehem, November 15, 1939

Acting President: Kenneth Johnson. Secretary-Treasurer: M. K. Ament, Lehigh University, Lehigh, Pa.

Lone Star, June 12, 1945

Acting President: H. S. Zane, Jr. Directors: E. H. Brooks, G. H. Brown, S. P. Hamer, A. A. Hardy, F. L. Lebus, G. G. McDonald, Charles Medley, F. A. Pierce, H. S. Zane, Jr. Secretary-Treasurer: W. M. Harrison, 1111 Foch Street, Fort Worth, Tex.

Los Angeles, May 27, 1936

President: W. C. Main. Vice-President: M. M. Mitchell. Directors: H. L. Clark, R. O. Cragin, Trevor Gardner, W. C. Main, M. M. Mitchell, C. H. Nazro, K. T. Norris, Maurice Pendleton, J. B. Rauen, S. K. Rindge, John Spalding, R. H. Taylor, Phillip Thayer, H. C. Thomas, Carleton Tibbetts. Treasurer: S. K. Rindge. Secretary: C. H. Nazro, P. O. Box 2262, Terminal Annex, Los Angeles 54, Calif.

LOCAL POSTS OF THE ASSOCIATION

Massachusetts Institute of Technology, January 20, 1922

President: T. W. Folger. Vice-President: A. R. Pfeiffenberger. Directors: G. J. Hossfeld, J. J. Moran, Jr., J. M. Wilson. Treasurer: R. K. Pitler. Secretary: E. A. Scott, Massachusetts Institute of Technology, Cambridge 39, Mass.

Michigan, December 12, 1942

President: R. L. Biggers. 1st Vice-President: Oscar Webber. 2nd Vice-President: C. T. Fisher, Jr. Directors: H. W. Alden, R. L. Biggers, R. P. Briggs, G. T. Christopher, M. E. Coyle, G. R. Fink, C. T. Fisher, Jr., H. C. Fruehauf, E. T. Gusheé, Phil Huber, K. T. Keller, G. W. Kennedy, S. T. Stackpole, Oscar Webber, A. M. Wibel. Secretary-Treasurer: J. W. Paynter, 1206 Woodward Avenue, Detroit 26, Mich.

Mid-Continent, December 12, 1944

President: Frank Hinderliter. 1st Vice-President: R. R. King. 2nd Vice-President: George Nicholson. Directors: The officers and M. H. Johnson, H. E. McCray, Walter O'Bannon, Jr., W. W. Siegrist, W. H. Stueve, Ed Warmack. Secretary-Treasurer: C. R. Horton, 510 S. Lansing Avenue, Tulsa 5, Okla.

Midwest, May 16, 1945

President: Harry Darby. 1st Vice-President: J. C. Shepherd. 2nd Vice-President: C. M. Standiford. Directors: L. M. Alexander, P. A. Froeschl, P. F. Rahm, R. M. Williams, E. J. Ziegler. Secretary-Treasurer: F. B. Nichols, 1921 Central Street, Kansas City 8, Mo.

Milwaukee, September 26, 1928

President: F. D. Hansen. Vice-President: N. R. Knox. Directors: F. R. Bacon, P. H. Batten, L. R. Clausen, W. W. Coleman, J. E. DeLong, H. S. Falk, G. H. Fobian, Walter Geist, F. D. Hansen, H. S. Johnson, Jr., N. R. Knox, H. V. Kohler, J. C. Merwin, R. A. Uihlein, P. J. E. Wood. Secretary-Treasurer: Jacobus Kruyne, Marshall & Ilsley Bank, 721 N. Water Street, Milwaukee 2, Wis.

Nebraska, June 22, 1944

President: C. D. Ammon. Vice-President: W. S. Byrne. Directors: D. C. Bradford, Ben Hughes, C. L. Kirkland, J. L. McCague, K. E. Vogel. Secretary-Treasurer: F. G. Arkoosh, 1305 Farnam Street, Omaha 2, Nebr.

New York, June 15, 1921

President: H. M. Tillinghast. 1st Vice-President: C. S. Comeaux. 2nd Vice-President: J. E. McNary. 3rd Vice-President: T. E. Murray. 4th Vice-President: J. T. Mackey. Executive Committee: The officers and T. F. Brown, W. A. Davidson, R. E. Gillmor, C. J. Hardy, C. W. Keuffel, D. B. MacMaster, Chester Mueller, Whitney Stone, A. E. Van Cleve. Treasurer: Crosby Field. Secretary: Edward Gluck, 111 East 16th Street, N. Y. C.

Northwest, March 15, 1945

President: H. A. Bullis. Vice-Presidents: W. C. MacFarlane, H. W. Sweatt. Directors: A. P. Baston, Fred Blumers, P. G. Bourne, C. E. Buckbee, R. P. Carlton, C. L. Horn, W. F. Kasper, L. S. Oakes, D. W. Onan, G. H. Rozum, W. G. Seeger, D. A. Smith, A. V. Stallard, H. A. Washburn, A. M. Wilson, F. B. Winston, Brison Wood. Secretary-Treasurer: R. F. Wilson, Palace Building, Minneapolis 1, Minn.

Philadelphia, December 9, 1926

President: W. J. Meinel. Vice-Presidents: G. W. Elliott, D. N. Hauseman, C. J. Ingersoll, T. D. Barney. Directors: G. M. Barnes, E. G. Budd, Jr., G. W. Elliott, H. W. Gadsden, H. P. Gant, A. W. Gilmer, C. H. Godschall, D. N. Hauseman, L. E. Hess, C. J. Ingersoll, Ralph Kelly, E. J. Langham, W. J. Meinel, R. P. Page, W. C. Pew, C. S. Redding, Wilbert Wear. Secretary-Treasurer: W. F. Feustel, 261 North Broad Street, Philadelphia 7, Pa.

Pittsburgh, February 24, 1927

President: H. C. Minton. Vice-Presidents: J. K. B. Hare, T. E. Millsop. Directors: The officers and F. B. Bell, R. C. Downie, W. K. Fitch, H. A. Gidney, L. Iversen, A. E. Walker, I. E. Wilson. Treasurer: T. H. Eddy. Secretary: W. S. Rial, Jr., 1312 Highland Building, Pittsburgh, Pa.

Puget Sound, January 25, 1944

President: Ferdinand Schmitz, Jr. 1st Vice-President: H. P. Lawrence. 2nd Vice-President: Robert Nelson. Directors: Frank Berry, John Cannon, Edward Colbert, L. B. Cooper, J. A. Denn, Watt Fallis, Alexander Finlayson, Henry Isaacson, G. E. Lamb, F. B. Lee, A. F. Parker, W. F. Schiessl, F. W. Schmidt, Walter Toly, R. O. Welch. Secretary-Treasurer: C. W. Huffine, 414 White Building, Seattle 4, Wash.

Quad Cities-Iowa, May 28, 1945

President: T. E. Stahl. Vice-President: E. W. Ross. Directors: Frank Anderson, R. E. Choate, J. H. Diedrich, L. M. Gildea, Henry Lord, K. E. Madden, Fred Maytag, II, C. R. Sheaffer, George Uhlmeyer, C. A. Waldmann, G. L. Weissenburger, C. D. Wiman. Secretary-Treasurer: Donald Meyers, Rock Island Arsenal, Rock Island, Ill.

Rocky Mountain, June 10, 1942

President: Watrous C. Redfield. Vice-President: James Colasanti. Directors: Alfred W. Ainsworth, J. Leslie Brown, Fred R. Eberhardt, Benjamin C. Essig, Joe K. Garretson, Robert P. Gutshall, James D. Maitland, William M. Reno, G. A. Savin, Henry A. Winter. Secretary-Treasurer: John V. Therrell, Jr., 601 Continental Oil Building, Denver, Colo.

St. Louis, January 18, 1927

President: Edwin B. Meissner. Vice-President: Clyde H. Morgan. Directors: W. M. Akin, Ben Comfort, H. B. Deal, R. E. Gardner, Jr., Spencer Olin, W. S. Symington, P. J. Watson, Jr. Secretary-Treasurer: M. F. Hubbell, 4800 Goodfellow Boulevard, St. Louis 20, Mo.

San Francisco, October 17, 1923

President: W. A. Starr. Vice-Presidents: E. A. Julian, R. M. Alvord. Directors: R. C. Force, K. B. Harmon, E. A. Julian, C. E. Moore, Carl Wente, C. S. Wheeler, Jr., Dean Witter. Secretary-Treasurer: R. L. Bidwell, P. O. Box 567, 100 McAllister Street, San Francisco 1, Calif.

Texas, October 30, 1942

President: F. M. Wittlinger. Vice-President: Herman Brien. Directors: W. O. Hedrick, E. D. Konken, D. J. Martin, L. B. Ryon, R. H. Startzell, Ross Stewart. Secretary-Treasurer: L. S. Bassett, P. O. Box 2545, Houston 1, Tex.

University of Michigan, February 20, 1941

President: L. E. Girton. Vice-President: R. W. Parkinson, Jr. Treasurer: H. J. Newman. Secretary: A. W. Ott, 213 Hinsdale House, Ann Arbor, Mich.

Washington, November 18, 1925

President: F. W. Foster Gleason. Vice-Presidents: C. M. White, Philip Schwartz. Advisory Board: Donald Armstrong, H. P. Erwin, C. T. Harris, Frank Macconochie, Earl McFarland, C. M. Wesson, F. E. Wright. Directors: H. T. Bodman, W. F. Byrne, R. C. Coupland, Bourbon Dawes, Harry Diamond, A. F. Ferrandou, T. C. Gentel, B. R. Lewis, A. W. Mace, H. H. Mitchell, A. A. White, R. P. Williams. Secretary-Treasurer: H. J. Crager, 705 Mills Bldg., Washington 6, D. C.

Yankee, June 30, 1925

President: J. S. Crawford. 1st Vice-President: F. L. Felton. 2nd Vice-President: H. W. Bagnall. 3rd Vice-President: F. W. Knauth. Directors: J. P. Spang, Jr., *chairman;* H. S. Chafee, Ralph Gow, R. N. Greenwood, Richard Morse, J. L. Martin, G. W. Sweet, Thomas West, R. F. Williams. Secretary-Treasurer: G. P. Slade, 140 Federal Street, Boston 10, Mass.

A.O.A. COMMITTEES AND DIVISIONS

NATIONAL DIVISIONS

Artillery Division

Executive Committee: J. E. Trainer, Firestone Tire & Rubber Company, Akron, Ohio, *chairman;* J. L. Auer, R. Hoe & Company, New York, N. Y.; John T. Brown, Chain Belt Company, Milwaukee, Wis.; Trevor Davidson, Bucyrus-Erie Company, South Milwaukee, Wis.; E. S. Dulin, Byron Jackson Company, Los Angeles, Calif.; W. J. Fisher, A. B. Farquhar Company, York, Pa.; L. Iversen, Mesta Machine Company, West Homestead, Pa.; N. R. Knox, Bucyrus-Erie Company, South Milwaukee, Wis.; E. R. Leeder, Martin-Parry Corporation, York, Pa.; W. H. Mitchell, Ridgewood Steel Company, Carthage, Ohio; Robert I. Martin, United Shoe Machinery Company, Beverly, Mass.; L. A. Petersen, Otis Elevator Company, New York, N. Y.; V. W. Peterson, Hannifin Manufacturing Company, Chicago, Ill.; S. E. Skinner, General Motors Corporation, Lansing, Mich.; E. G. Williams, American Type Founders, Inc., Elizabeth, N. J.; C. W. Wright, Pullman-Standard Car Manufacturing Company, Washington, D. C.

Fire Control Instrument Division

Executive Committee: Stanley C. Hope, Gilbert & Barker Manufacturing Company, West Springfield, Mass., *chairman;* R. E. Gillmor, Sperry Gyroscope Company, New York, N. Y.; R. L. Goetzenberger, Brown Instrument Company, Philadelphia, Pa.; Myron Hayes, Eastman Kodak Company, Rochester, N. Y.; F. R. Lack, Western Electric Company, New York, N. Y.; J. T. Mackey, Mergenthaler Linotype Company, Brooklyn, N. Y.; Harold W. Sweatt, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.; Gordon B. Welch, Linotone Corporation, New York, N. Y.

Gage Industry Division

Executive Committee: Louis Polk, Sheffield Corporation, Dayton, Ohio, *chairman;* Erik Aldeborgh, Standard Gage Company, Poughkeepsie, N. Y.; E. J. Bryant, Greenfield Tap and Die Corporation, Greenfield, Mass.; Arthur F. Wentzel, Air Matériel Command, Wright Field, Ohio; Harry B. Hambleton, Brielle, N. J.; Charles M. Pond, Pratt & Whitney, West Hartford, Conn.; F. S. Blackall, Jr., Taft-Peirce Manufacturing Company, Woonsocket, R. I.; Ray W. Rice, Quality Tool and Die Company, Indianapolis, Ind.; F. C. Tanner, Federal Products Corporation, Providence, R. I.; W. P. Henry, Navy Bureau of Ordnance, Washington, D. C.

Rocket, Bomb, and Artillery Ammunition Division

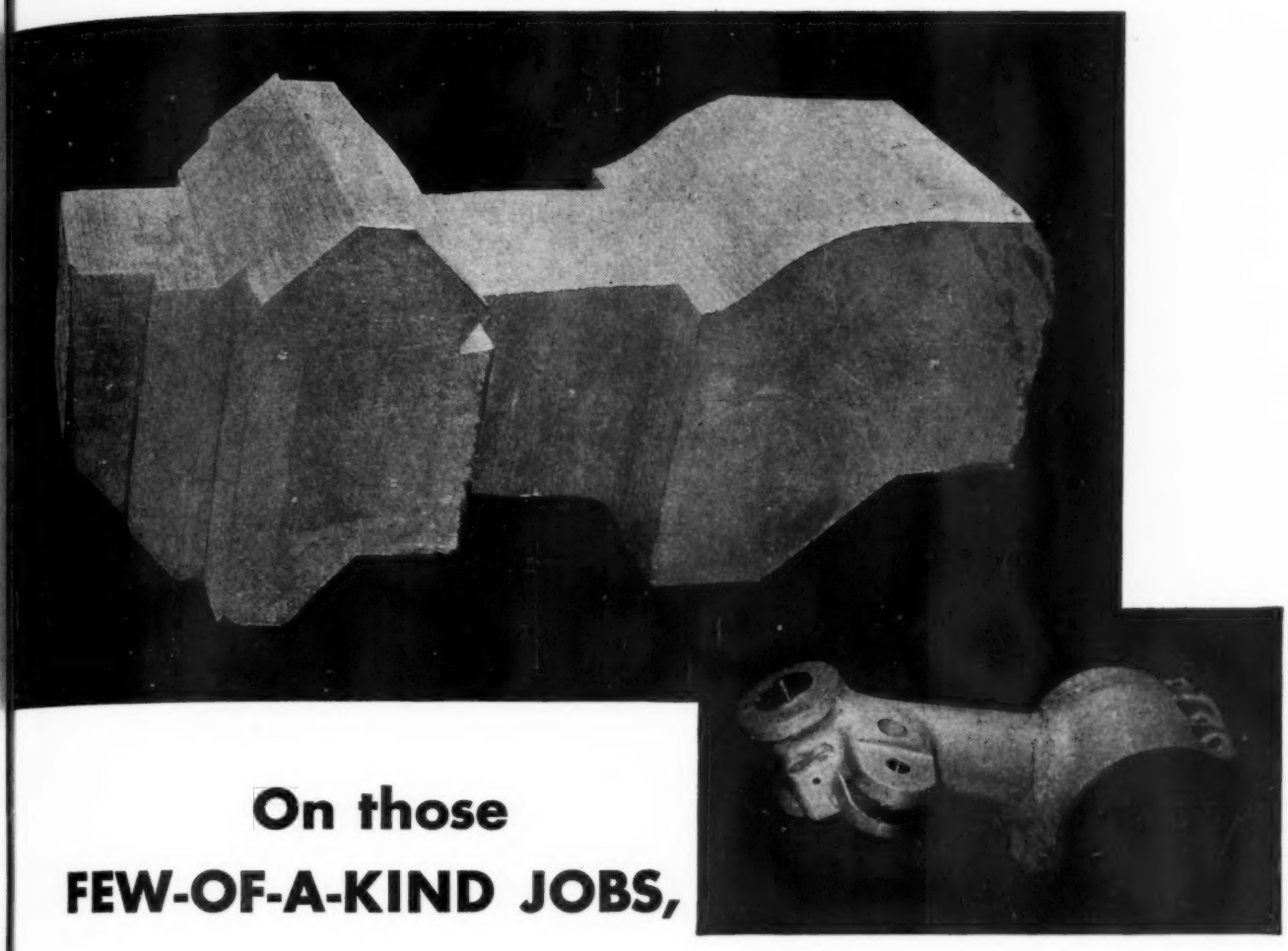
Harvey C. Knowles, Procter & Gamble Company, Cincinnati, Ohio, *Division chairman;* J. A. Meek, Firestone Tire & Rubber Company, Akron, Ohio, *deputy chairman;* R. H. Kellogg, Procter & Gamble Company, Cincinnati, Ohio, *Division secretary. Rocket and Shell Committee:* S. E. Skinner, Oldsmobile Division, GMC, Lansing, Mich., *chairman. Cartridge Case Committee:* K. T. Norris, Norris Stamping and Manufacturing Company, Los Angeles, Calif., *chairman;* W. L. Chandler, Fulton Sylphon Company, Knoxville, Tenn.; W. J. Gazey, Ekco Products Company, Chicago, Ill.; Frank German, Plume & Atwood Manufacturing Company, Thomaston, Conn.; H. M. Heckathorn, Mullins Manufacturing Corporation, Salem, Ohio; A. C. Kieckhafer, West Bend Aluminum Company, West Bend, Wis.; W. H. Miller, Bossert Company, Utica, N. Y.; C. L. Patterson, Lamp Division, Electric Auto-Lite Company, Cincinnati, Ohio; N. H. Preble, Dura Division, Detroit Harvester Company, Detroit, Mich.; M. L. Sperry, Jr., Scovill Manufacturing Company, Waterbury, Conn.; H. W. Steinkraus, Bridgeport Brass Company, Bridgeport, Conn.; H. B. Stoner, Stoner Manufacturing Corporation, Aurora, Ill.; J. A. Watson, Motor Wheel Corporation, Lansing, Mich. *Material Subcommittee:* Dr. Anson Hayes, Research Division, American Rolling Mill Company, Middletown, Ohio; K. F. Thornton, Development Division, Aluminum Company of America, Westmoreland, Pa.; H. C. Larson, Bethlehem Steel Company, Bethlehem, Pa. *Technical Subcommittee:* H. M. Day, Ekco Products Company, Chicago, Ill.; E. M. Wagner, San Marino, Calif. *Powder and Explosives Committee:* J. M. Skilling, Military Explosives Division, E. I. du Pont de Nemours & Company, Wilmington, Del., and Henry N. Marsh, Hercules Powder Company, Wilmington, Del., *cochairmen. Bomb Committee:* R. Furrer, American Car and Foundry Company, New York, N. Y., *chairman. Fuze Committee:* William Steinwedell, Stewart-Warner Corporation, Chicago, Ill., *chairman. Loading Committee:* M. P. Woodward, Procter & Gamble Company, Cincinnati, Ohio, *chairman.*

Small Arms and Small Arms Ammunition Division

Executive Board: C. K. Davis, Remington Arms Company, Bridgeport, Conn., *chairman;* F. F. Hickey, Savage Arms Corporation, Utica, N. Y., *deputy chairman;* Wallace L. Clay, Remington Arms Company, Bridgeport, Conn., *secretary;* Graham H. Anthony, Colt's Patent Fire Arms Manufacturing Company, Hartford, Conn.; E. S. Burke, Kelly-Springfield Tire Company, Cumberland, Md.; Ward M. Canaday, Willys-Overland Motors, Inc., Toledo, Ohio; C. Stewart Comeaux, Sporting Arms and Ammunition Manufacturers Institute, New York, N. Y.; C. Donald Dallas, Revere Copper and Brass, Inc., New York, N. Y.; Arthur G. Drefs, McQuay-Norris Manufacturing Company, St. Louis, Mo.; C. L. Horn, Federal Cartridge Company, Minneapolis, Minn.; O. E. Hunt, General Motors Corporation, Detroit, Mich.; J. W. McGovern, United States Rubber Company, New York, N. Y.; John M. Olin, Olin Industries, Inc., East Alton, Ill.; Philip D. Wagoner, Underwood-Elliott-Fisher Company, New York, N. Y.; T. J. Watson, International Business Machines Corporation, New York, N. Y. *Rifles and Carbines Committee:* Edwin Pugsley, Winchester Repeating Arms Company, New Haven, Conn., *chairman;* H. A. Brown, Remington Arms Company; C. A. Kirk, International Business Machines Corporation; John O'Brien, Inland Manufacturing Division, GMC; F. R. Valpey, Standard Products Company. *Machine Guns, Belts, Links Committee:* G. A. Wilson, High Standard Manufacturing Company, New Haven, Conn., *chairman;* G. S. Cole, Jr., Brown-Lipe-Chapin Division, GMC; W. J. Foster, AC Spark Plug Division, GMC; F. H. Groesbeck, Savage Arms Corporation; James W. Pattison, Kelsey-Hayes Wheel Company; George Webb, Colt's Patent Fire Arms Manufacturing Company. *Small Arms Ammunition Committee:* E. C. Hadley, Remington Arms Company, Bridgeport, Conn., *chairman;* George L. Dawson, Western Cartridge Company; Robert R. Ehlen, Federal Cartridge Company; A. J. Mummert, McQuay-Norris Manufacturing Company; C. L. Wanamaker, United States Rubber Company. *Pistols and Revolvers Committee:* Paul Krumm, Colt's Patent Fire Arms Manufacturing Company, Hartford, Conn., *chairman;* G. E. Bauder, Remington Rand, Inc.; C. R. Hellstrom, Smith & Wesson Company; H. E. Howland, Ithaca Gun Company; Gordon Swebilius, High Standard Manufacturing Company. *Helmets, Bayonets, Trench Knives Committee:* Percy L. Barter, McCord Corporation, Detroit, Mich., *chairman;* A. Edward Allen, Utica Cutlery Company; M. P. Day, Carnegie-Illinois Steel Corporation; J. S. Nicholas, Union Fork & Hoe Company; Carl Wessner, Sharon Steel Corporation.

Machine Tool Committee

Walter Tangeman, Cincinnati Milling Machine Company, Cincinnati, Ohio, *chairman;* Herbert H. Pease, the New Britain Machine Company, New Britain, Conn.; A. H. Eggers, Greenlee Brothers & Company, Rockford, Ill.; Haviland Wright, Wright & Gade Tool Company, Philadelphia, Pa.; Richard E. LeBlond, R. K. LeBlond Machine Tool Company, Cincinnati, Ohio; Richard A. Heald, Heald Machine Company, Worcester, Mass.; George H. Johnson, Gisholt Machine Company, Madison, Wis.



On those FEW-OF-A-KIND JOBS,

save yourself a lot of hogging . . .

Use Alcoa Aluminum Hand Forgings

185 pounds of aluminum were cut off this Alcoa Aluminum Hand Forging before the customer's machine shop received it. Instead of ordering a 450-pound solid aluminum block to make this 100-pound experimental landing gear trunnion, he ordered this Alcoa Aluminum Hand Forging that weighs only 265 pounds.

When you build experimental models or few-of-a-kind parts, order Alcoa Aluminum Hand Forgings and save time and money. The general shape can be blocked out for you . . . no costly forging dies are needed. And because no dies are required, you can get Hand Forgings in a hurry.

You save unproductive hogging and machining that ties up machines and man power. You get stock that is solid throughout. Tensile strength is high . . . up to 82,000 psi. tensile. Machining goes fast.

We'll be glad to show you how to speed production and save money by using Alcoa Aluminum Hand Forgings for short-run parts where high tensile strength is needed. Write to ALUMINUM COMPANY OF AMERICA, Gulf Bldg., Pittsburgh 19, Penna. Sales offices in 54 leading cities.

ALCOA ALUMINUM

IN EVERY COMMERCIAL FORM

REMOVE METAL *Fast*

with these Brown & Sharpe SIDE MILLS

SIDE MILLING CUTTERS

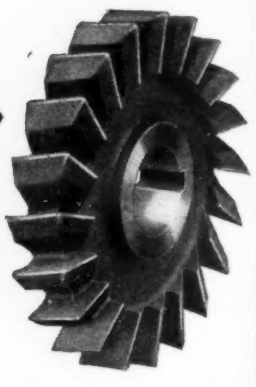
Frequently used in pairs for sizing nuts, bolt heads and similar work. Have cutting edges on both sides of teeth as well as periphery.

STAGGERED TOOTH SIDE MILLING CUTTERS

Alternate right and left hand spiral angles with considerable angle of undercut permit cutters to remove large amounts of metal without destructive vibration and chatter. Used in pairs as interlocking cutters.

HALF SIDE MILLING CUTTERS

Used for side cuts, as in straddle milling or in cutting slots where complete bottom finish isn't required. Spiral on top and undercut on side give teeth improved cutting action.



• • •

PUT ANY ONE OF THESE Brown & Sharpe Side Milling Cutters to work on a piece of metal and that metal will take shape quickly and accurately. Benefit by the inherent qualities of Brown & Sharpe design and craftsmanship that set the pace for all types of cutters . . . in speed, accuracy and number of pieces per sharpening. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A. B·S

We urge buying through the Distributor

BROWN & SHARPE

New Developments

GROUND

SPECIAL WEAPONS PROJECT

The War and Navy Departments have announced a program and plan of operations for the Armed Forces Special Weapons Project.

Included in the program of the project is the training of special personnel, military participation in the development of atomic weapons of all types, and the developing and effecting of joint radiological safety measures in coördination with established agencies. Close liaison with the Atomic Energy Commission is maintained through the Military Liaison Committee.

AIR WARNING NETWORK PLAN

An air warning network of the kind which might have prevented the Pearl Harbor disaster is now being pushed jointly with the related problem of expanding civil and military air navigation facilities. Inquiry in the armed forces revealed that the continental limits of the United States were little better protected against a sneak attack than they were on December 7, 1941.

TRANSPORTER FOR HEAVY GUN

The Ordnance Department has been testing the heavy tank transporter T8 as a carrier for superheavy antiaircraft guns. This vehicle has a detachable deck or hull suspended between two prime-mover units. The deck will support the gun along with two outriggers for firing stability and can be lowered into position in a little over a minute. The design will also permit the gun to be fired from traveling position.

The vehicle is powered by two 500-horsepower engines, can negotiate a thirty per cent grade fully loaded, and can cruise at over thirty-five m.p.h. The 6-foot tires permit it to go through thirty inches of mud and step over a 36-inch wall.

INSIDE-OUT MOTORS

Three tiny electric motors, unique in that they are "inside out," have been built by General Electric for use in testing the aërodynamics of spinning missiles at Aberdeen Proving Ground.

Only 1¾ inches in diameter and 6 inches long, the motors are rated at one-tenth horsepower and have an extreme speed of 80,000 revolutions a minute. They are mounted in projectiles being tested at supersonic speed in a wind tunnel.

The stator, which is normally the stationary outside case, in these motors is on the stationary shaft. The outside cases forms the rotor and rotates around the shaft.

When mounted inside a missile, the external frame of the motor is fastened to the projectile's case, spinning it at high speeds so that its aërodynamic characteristics at supersonic speeds may be observed and measured.

AUTOMATIC CAMERA

A camera that will take pictures automatically as fast as the photographer can trip the shutter is under development in the Signal Corps Engineering Laboratories at Fort Monmouth, N. J. A range finder will focus the camera as the photographer sights on his picture, and the film will be moved automatically to the next exposure. There will be three lenses for taking pictures at various distances. As the film moves, the shutter will be cocked, ready to take another picture as fast as the photographer can trip it again.

(*Continued on p. 296*)

LOOK WHO'S *pulling!*

HOOKS A BIG ONE—The tugboat *Rio Vista*, out of Rio Vista, California, heads up the Sacramento River with the dredger *Neptune*. She is powered by a "Caterpillar" Diesel D17000 Marine Engine.

SHE may look small, but down where it counts this little giant-puller has the power it takes to buck ocean tides and river currents with the best of them.

A Corps of Engineers towboat, the *Rio Vista*, gets her muscles from a powerful 8-cylinder, 135-hp. "Caterpillar" Diesel Marine Engine which swings a 51″ x 40″ propeller at 900 R.P.M. Even with heavy loads day after day, this sturdy, dependable engine required only one overhaul in its first 11,000 hours. And it's still going strong.

For long life and reliability at lowest costs, you can't beat "Caterpillar" Diesel Marine Engines. There's plenty of heavy-duty performance in them and they're built to tackle the toughest jobs.

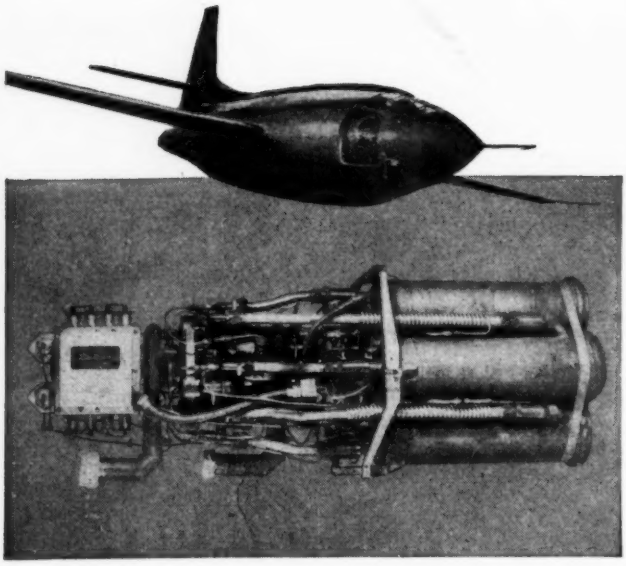
CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

CATERPILLAR DIESEL

REG. U. S. PAT. OFF.

Marine Engines

NEW ROCKET ENGINE FOR SUPERSONIC PLANE



built with a "heart" of Stainless Steel Tubes

With full rocket blast, this engine develops 6,000-pounds thrust — sufficient to crash through the "sonic barrier" and propel a plane at speeds up to 1,700 M.P.H.

The combustion chambers and the manifold tubes, which the manufacturer* describes as the heart of the engine, are made from Seamless Stainless Steel Tubes.

Stainless Steel Tubes made by the seamless process were used to assure maximum heat resistance, strength, and safety without adding unnecessary weight. No other tubing surpasses stainless steel for high temperature applications like this.

The metallurgists at National Tube who helped solve rocket engine problems are equally capable of aiding in solving other problems involving high temperatures, corrosion, and erosion.

U·S·S Shelby Seamless Tubing can be used in numerous applications where its strength and light weight will improve product design.

Write for complete information on analyses and sizes of tubing available.

*Reaction Motors, Inc.
Dover, New Jersey

NATIONAL TUBE COMPANY
PITTSBURGH, PA.
Tubing Specialties Division
Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

UNITED STATES STEEL

New Developments

RECTIFIER FOR PHOTO MAPPING

An automatic focus rectifier for mosaic map making, the first ever to be produced in America, was delivered recently to the Army Corps of Engineers by Bausch & Lomb Optical Company.

Resembling an ordinary photo enlarger, it simultaneously enlarges, prints, and automatically reduces aërial photographs to a common scale and level, correcting the tilt encountered as a result of the plane's variation in angle and level at the time photographs are taken.

Equipped with push-button controls, the automatic instrument can be operated by a photographer, turning out rectified prints on a production-line basis at the rate of one every five minutes. Previous nonautomatic rectifiers required tedious, involved mathematical calculations for each individual photograph.

ROCKETS LAY TELEPHONE WIRE

The use of rockets in laying lightweight field telephone wire over inaccessible terrain by means of an improved type wire dispenser has been proved practical by recent Signal Corps tests at Fort Dix, N. J.

A distinct advantage of the rocket method of laying wire lies in the simplicity and portability of the equipment required. One man equipped with a wire dispenser, a small field telephone and a rocket can establish wire communication for relatively short distances over rivers, lakes, ravines, cliffs, and other formidable obstacles.

BLIZZARDS TO ORDER

Man-made blizzards, equaling the intensity of storms experienced in the most remote Arctic regions, are being manufactured at will by engineers in the climatic test chambers of the Signal Corps Engineering Laboratories at Fort Monmouth, N. J., to test military equipment under simulated Arctic climatic conditions.

The results are considered of major importance as compared with previous snow-making endeavors which were confined to refrigerating machines. These produced snowflakes, but not in the 3- to 4-inch depth which makes Signal apparatus testing possible in a chamber large enough to house many men and many articles of equipment.

The made-to-order snow storm is produced in a large low-temperature test chamber, slightly larger than a 4-room house, and spacious enough to accommodate a large truck and trailer.

SEA

SUPER GAS FOR NAVY PLANES

A new, superoctane gasoline which steps up aircraft engine power as much as fifteen per cent is being used by Navy combat planes. This power increase is gained by substituting the new fuel for the 100-octane, grade 100/130, gasoline used extensively in World War II. The power increase is shown in higher speeds, faster rates of climb, and ability to carry greater pay loads longer distances. The effectiveness of the Navy's missions of attack, defense, transport, and patrol are increased accordingly. The new fuel is considered by petroleum experts to be the ultimate in aviation gasoline as it is the highest performing gasoline that could be produced in the quantity required in time of emergency. Fleet units and all naval air bases outside continental United States are being supplied with it on a priority basis.

MARINE HELICOPTER SQUADRON

The Marines' first helicopter squadron, HMX-1, was commissioned at the Marine Corps Air Station, Quantico, on De-

★

CONSTANT PROGRESS . . . THROUGH RESEARCH

COLD ROOM

at Continental Motors makes possible "in-use" tests of engines at temperatures as low as –50° F.

HIGH-SPEED MOVIES

— up to 8,000 frames per second — reveal details of operation formerly unobservable, and facilitate development both of materials and of design.

DYNAMOMETER TEST

department with 14 completely-equipped stalls is used to improve performance characteristics of Red Seal engines.

ANGLE TESTING

of engines permits study of operation in any position which the engine might assume in actual use. It is especially important, in engines intended for use in out-of-normal position, that the operation of oiling and carburetion in such positions be checked.

CONTINENTAL

Red Seal

ENGINES

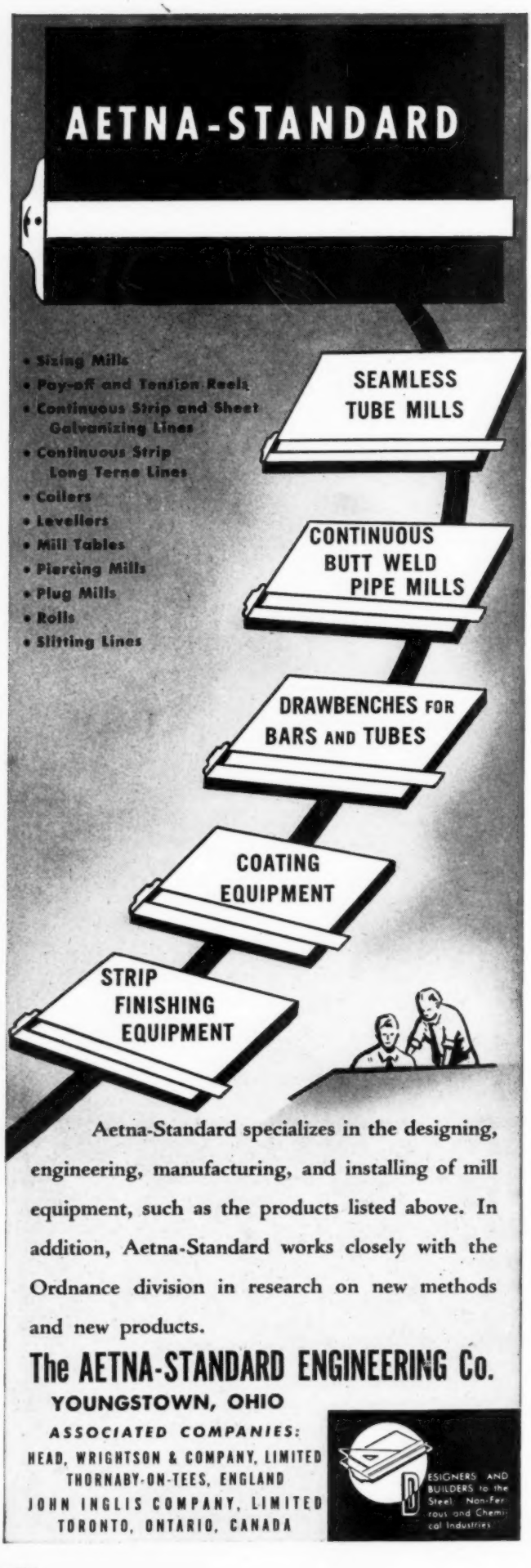
Continental Motors maintains one of the country's most progressive engineering staffs, backed by first-rate facilities for development work.

This organization's sole objective is the development of better engines, through improvement in manufacturing technique, as well as in materials and design. As a result of its work, Continental engines undergo constant refinement, making for finer performance, lower cost of maintenance, adaptability to an ever-wider variety of specialized jobs.

New, high-performance Continental engines range all the way from 7 to 250 h.p. Three new full Diesels are also in production now. Continental Motors' extensive research and engineering facilities are available at all times for the development of engines for a specific job.

Continental Motors Corporation

MUSKEGON, MICHIGAN


AETNA-STANDARD
• Sizing Mills
• Pay-off and Tension Reels
• Continuous Strip and Sheet Galvanizing Lines
• Continuous Strip Long Terne Lines
• Coilers
• Levellers
• Mill Tables
• Piercing Mills
• Plug Mills
• Rolls
• Slitting Lines
SEAMLESS TUBE MILLS
CONTINUOUS BUTT WELD PIPE MILLS
DRAWBENCHES FOR BARS AND TUBES
COATING EQUIPMENT
STRIP FINISHING EQUIPMENT
Aetna-Standard specializes in the designing, engineering, manufacturing, and installing of mill equipment, such as the products listed above. In addition, Aetna-Standard works closely with the Ordnance division in research on new methods and new products.
The AETNA-STANDARD ENGINEERING Co.
YOUNGSTOWN, OHIO
ASSOCIATED COMPANIES:
HEAD, WRIGHTSON & COMPANY, LIMITED
THORNABY-ON-TEES, ENGLAND
JOHN INGLIS COMPANY, LIMITED
TORONTO, ONTARIO, CANADA
DESIGNERS AND BUILDERS to the Steel, Non-Ferrous and Chemical Industries

cember 1, 1947. The helicopters to be used will be the 4-passenger Sikorsky HO3S-1 and the Piasecki HRP-1, which can carry a crew of two plus eight passengers or a ton of pay load.

THE SKYROCKET

Rocket power, supplementing jet-engine propulsion, features the new Navy transonic Skyrocket plane revealed at El Segundo, Calif.

The new plane, dubbed a winged V-2, is designed to approach the speed of sound, which is approximately 760 miles an hour at sea level. It is a research craft to gather information relative to problems encountered at those speeds. It is powered with a Westinghouse turbo-jet engine and with a rocket engine built by Reaction Motors, Inc. Known as the D-558-2 by the Navy, the new plane is radically different in appearances from the D-558 Skystreak because of its needlelike nose, its slimly tapered fuselage, and its stubby swept-back wings which give a total wingspan of only twenty-five feet.

NAVY ROCKET FACILITY

Navy plans for a permanent rocket research facility are a step nearer with the announcement of an initial contract for "a study of requirements" with the Aerojet Engineering Company, Azusa, and the Ralph M. Parsons Company of Los Angeles, Calif.

SECRET TORPEDO EXPERIMENTS

Rising from the shore of a mountain reservoir north of Azusa, Calif., is a huge concrete-and-steel secret of war so well kept that after two years of peace its function up to now has been known only to the scientists and Navy men responsible for its operation.

The secret is a 300-foot steel tube, nearly two feet in diameter, which angles from the top of a bluff down almost to the surface of the waters impounded by Morris Dam.

Through this tube, with aircraft speed, go torpedoes which may well become the prototypes of underwater missiles to be used in any future war.

From studying the behavior of these projectiles as they split the water at unbelievable speeds, scientists are evolving strange-shaped missiles which are a far cry from the torpedoes of the last two wars.

FIRST GRUMMAN JET FIGHTER

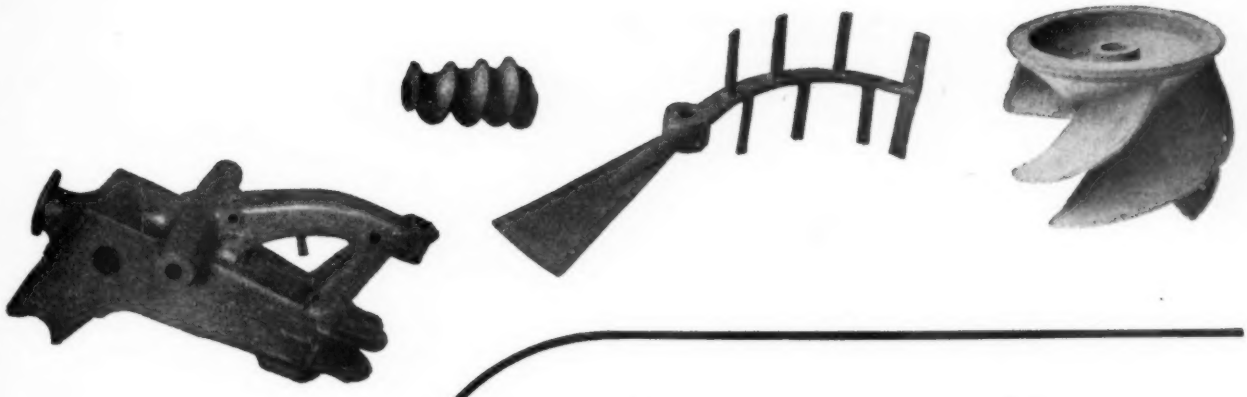
The Navy recently lifted the wraps on the first Grumman jet fighter, the 600-mile-an-hour-plus XF9F-2 Panther. Powered by the American built, British-designed "Nene" jet engine, developing 5,000 pounds' thrust, the XF9F-2 is the prototype for 40 more on order by Navy.

The Panther with its 31-foot square-tipped wings, which may be folded for shipboard accommodation, can be pulled into the air after a ground run of less than 450 feet.

Secret of the Panther's terrific rate of climb is the incorporation of a movable leading edge—a wing-nose slot-flap which, when set in operation, creates a high wing camber, giving the plane better lift characteristics than any other jet plane. Landing speed is 80 to 85 miles an hour.

THE "WALKING BARGE"

A new amphibious vehicle, the "walking barge," which can carry sixty tons of men and material over sand, soft and hard ground, oozy-to-liquid mud, tidelands, surf and ocean, and can climb steep embankments and traverse uneven terrain, all in a sort of leapfrog motion, has been developed by the Navy's Bureau of Yards and Docks at the Advanced Base Depot Proving Ground, Port Hueneme, Calif. With additional armor the barge might be used as a mobile fortress in covering foot troops during landing operations. It might also be used in Arctic transporta-



...because they're ONE-PIECE STEEL!

Cast steel served *hundreds* of combat purposes as nothing else could. One reason for the early adoption of cast steel armor for tanks was the speedier assembly made possible by *eliminating* riveted plates.

Muzzle brakes for guns were switched from forgings to on-size steel castings to get away from *slow* machining. 75 mm. pack howitzer slides were made of cast steel for light-weight *strength.* High-pressure steam line fittings on ships were cast steel for *dependability.* Cast steel is an excellent answer to many perplexing problems.

One-piece steel castings are uniform in size, shape, weight, strength. They do not depend for accuracy upon the varying skills and moods of *many* workmen, nor upon the human element in fabrication.

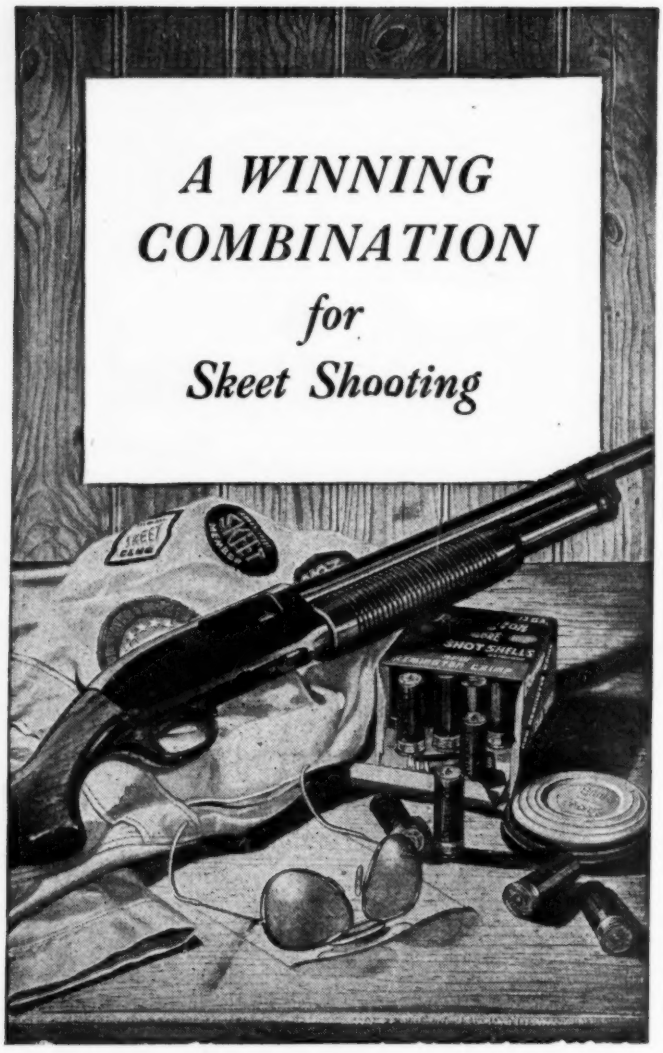
One-piece steel means no cutting or machining of component parts; no complicated jigs or forming tools; no rehandling; no cumulative errors; no subassemblies . . . no assembly *at all!* Exact duplication in any quantity is quick and simple routine.

Whatever may be required in development, design, and volume, the nation's largest producer of *fighting* cast steel is at your service with knowledge, experience, and facilities to help keep America strong.

AMERICAN STEEL FOUNDRIES

CHICAGO

MINT-MARK OF ⬡ FINE CAST STEEL



Skeet is a great sport—one you can enjoy for years to come. However, your fullest appreciation comes as your skill increases. And that's when you find that the *right* gun and the *right* ammunition count most.

Champion skeet shooters have found a *winning* combination in the Remington Model 31 shotgun and Remington Shur Shot shells with the New Remington Crimp. The Model 31 is a pump action repeating shotgun which, during the war, aerial gunnery students nicknamed "the gun with the 'ball-bearing' action" because of its velvety-smooth operation. And Shur Shot shells with the New Remington Crimp eliminate "blown patterns" which cause those unexplainable misses. There is no top wad to obstruct the shot charge. Thus, you get even distribution of shot pellets with no holes or openings for targets to pass through unbroken.

For free literature on this popular combination, write Remington Arms Company, Inc., Bridgeport 2, Conn.

Remington

DU PONT

"If It's Remington—It's Right"

Shur Shot is a trade mark of Remington Arms Company, Inc.

New Developments

tion where its power could be employed to haul snow trains containing men and equipment over snow and ice and over tundra turned to quagmire.

Of all-welded construction, the barge consists of three pontoons placed side by side. The 2 outboard pontoons, each 60 feet long, are 6 feet wide and 9 feet, 2 inches high. Between them is the inboard pontoon, 16 feet wide, 44 feet long, and 6 feet high.

On land, the barge moves in a sort of leapfrog motion. First the inboard pontoon is lifted seventeen inches off the ground, moves forward ten feet at this level, and is lowered to the ground. It is followed by the outboard pontoons, which are decked over and carry the payload. This part of the structure surges upward and forward in the same manner as the inboard pontoon and comes to rest in its original position over the inboard pontoon.

RADAR FIRE CONTROL

A recent report revealed that the Navy has designed a twin 3-inch automatic gun which may be an answer in part to the missiles of the future. It will be equipped with a revolutionary radar fire-control system by which the mount automatically picks up any enemy aircraft or missile, tracks it, computes all necessary corrections for windage, temperature, and similar factors, and opens fire at effective range.

AIR

LARGEST LAND PLANE

The world's largest land plane, the XC-99, built by the Consolidated-Vultee Aircraft Corporation, successfully completed its first test flight at Lindbergh Field, Calif., remaining aloft for one hour. The 6-engined giant is a cargo version of the Consolidated-Vultee B-36 heavy bomber. Wing span of the XC-99 is 230 feet. The 265,000-pound transport is capable of carrying 400 fully equipped combat troops, 335 litter patients, or 100,000 pounds of cargo. The XC-99 is designed for a top speed in excess of 300 miles an hour.

ARCTIC SURVIVAL SCHOOL

Realizing the need for thorough indoctrination of flying personnel in the methods of survival in the Arctic in the event of a crash, the Alaskan Air Command has organized an Arctic Polar Indoctrination School, based at Nome with a complement of forty-five instructor personnel. In continuous operation, the school will run all winter with a rotation of student personnel each week. Men are drawn from all Air Force installations in Alaska and flown to Nome where they are given preliminary instructions prior to the climax of the course—four days which are spent under simulated crash conditions in the loneliness of the Bering Sea icepack and the wild interior of Alaska.

RAM-JET HELICOPTER

The U. S. Air Force's McDonnell ram-jet helicopter, the first rotary-wing aircraft ever to employ this type of power plant, has successfully completed flight tests.

Developed after almost two years of research, the ram-jet helicopter is actually a three-dimensional aërial motorcycle consisting only of a 2-blade rotor, eighteen feet in diameter, with a ram-jet power unit at each tip, a small rudder, and an open steel tube structure supporting the pilot, fuel tanks, and controls.

LARGEST ASSAULT GLIDER

The "Avitruc," first and largest all-metal assault glider ever produced in this country, is known officially as the CG-18A. The "Avitruc" is 53 feet, 5 inches long; its wing span is 86 feet,

the best brake is AIR

BENDIX-WESTINGHOUSE AIR BRAKES

There's one sure way to prove the superiority of Air Brakes—ask your drivers—and the more experienced the better! They will tell you that without question Air Brakes make the heaviest vehicle easier to drive, and cut fatigue to a minimum on even the longest hauls. That spells maximum efficiency and safety for your loads and drivers. Furthermore, that extra efficiency shows up in improved schedules and lowered maintenance costs, too. No matter how you look at it—behind the wheel or the desk—your best investment lies in Bendix-Westinghouse Air Brakes, the overwhelming favorite on highways from coast to coast.

BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE CO., ELYRIA, OHIO

the best AIR brake is

Bendix-Westinghouse

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

the governor that
assures economy
of automotive
vehicle operation

The Handy Vari-Speed Governor used on many well-managed truck fleets over a period of years has proved its outstanding value in preventing costly operating practices.

A poll of 180 such fleets shows actual savings as follows:

General maintenance	26%
Engine repair	32%
Tire maintenance	22.6%
Insurance	16%
Lubrication	26%
Fuel	13.5%
Brake maintenance	29.2%
Accidents	37%

Other King-Seeley automotive instruments with long successful service records include:

- Telegages—Fuel level, oil pressure and water temperature
- Ammeters • Speedometers

Specify KS control instruments for greatest effectiveness and economy of automotive operation.

KING-SEELEY CORPORATION
ANN ARBOR MICHIGAN
PLANTS IN
ANN ARBOR • GRAND RAPIDS • YPSILANTI

New Developments

4 inches; height is 10 feet. An extremely thin wing, which decreases drag, simplifies the job of the towplane. Cargo-loading problems have been simplified in the CG-18A by means of a rear cargo ramp. Capable of carrying a cargo load of 8,000 pounds, 30 fully equipped combat troops, or 24 litter patients, the "Avitruc" has a design gross weight of approximately 15,000 pounds.

NEW HIGH-SPEED PARACHUTE

John F. Geary, U.S.N., veteran Chief Parachute Rigger, has designed and built an experimental parachute which may solve the problem of pilot safety during high-speed bailouts. The new design consists of a standard canopy with a 6-foot "cap" in the center. Under high stresses, such as encountered immediately after bailing out at high speed, the "cap" extends on elastic cords, spilling the air out the top. As the chute slows down the cap is drawn back to the chute, spillage is cut down, and the rate of descent is gradually decreased.

JETS IN THE ARCTIC

The U. S. Air Force's 94th "Hat-in-the-Ring" Squadron, equipped with Lockheed P-80B Shooting Star jet-propelled fighter planes, have been sent to Ladd Field, Fairbanks, Alaska, for the first mass tactical operation of jet aircraft in the Arctic. In order to be prepared for temperatures down to minus 65 degrees Fahrenheit, the planes were modified so that their Allison J-33 turbo-jet engines could be started with gasoline and switched later to kerosene, the regular jet fuel.

Other changes in the P-80B's include the use of new greases, cold-weather packing in hydraulic units, and the installation of an auxiliary electric heater-blower to assist in defrosting the windshield and canopy. Synthetic rubber, which becomes brittle in winter weather, has been replaced throughout the winterized P-80B's with natural rubber, particularly in the sealing of the pressurized cockpit.

ELECTRONICS END "STACKING"

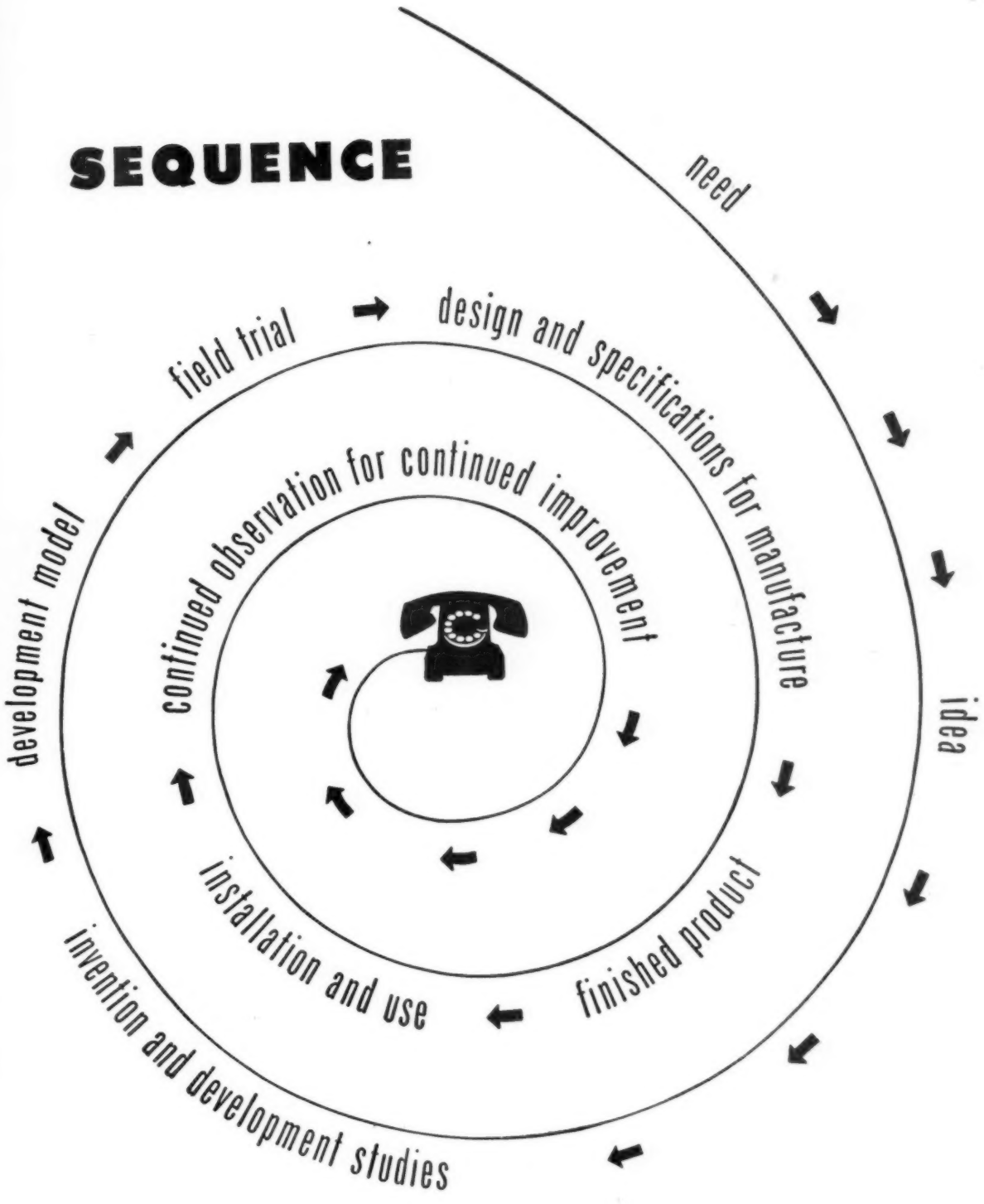
An electronic air traffic control device, capable of split-second computation, has been developed by the Minneapolis-Honeywell Regulator Company to eliminate "stacking" of aircraft over an airport during instrument flight weather. The electronic brain—known as the B-D Computer—masters two elements that cause error in aircraft navigation: making proper compensation for wind deviation during flight and computing elapsed time between airports. Main purpose of the B-D Computer will be to prevent the crowding of airways during instrument-flying periods by spacing planes on the same route in parallel "tracks." Under present methods aircraft are usually brought in during inclement weather in 15-minute intervals. With the B-D Computer, planes may be landed safely within seconds of each other.

NEW VERSION OF "PACKET"

The Air Force has awarded a contract for the delivery of 37 aircraft which will be new, improved versions of the Fairchild C-82 "Packet" to be known as the C-119. The main difference between the C-119 and the earlier version is engine power. The C-119 will employ 2 Pratt-Whitney Wasp Major engines with take-off ratings of 3,250 horsepower and normal continuous ratings of 2,650 horsepower up to an altitude of 6,000 feet, and 2,300 horsepower up to 18,000 feet.

Designed to carry a cargo load of nine tons for a range of 2,000 miles, the fuselage of the C-119 has ample space for a pay load of more than 10 tons, although its range decreases with added cargo. It is capable of accommodating forty-two fully equipped combat troops, as well as twenty parachute cans of supplies suspended from an overhead monorail.

SEQUENCE



At Bell Telephone Laboratories, more than 2300 scientists, engineers, and their associates are continually exploring and inventing, devising and perfecting for improvements and economies in telephone service.

BELL TELEPHONE LABORATORIES

For Peace

¶ On January 1, 1948, by mandate of the members the name of the Army Ordnance Association was changed to

American Ordnance Association

¶ Thus will be carried forward with renewed vigor the aims and purposes of America's foremost organization for scientific and industrial preparedness.

¶ Founded in 1919, the Association under its broadened title now enters the atomic age dedicated to the simple yet powerful proposition that the United States of America must be kept strong for the common defense—ashore, afloat, and aloft.

¶ This strength depends basically upon our traditional adherence to the spiritual, scientific, and industrial values which have made our Nation great. These are our best guaranty of national security and peace.

¶ In striving to attain these ends the Association seeks the active coöperation and support of all American citizens, both men and women.

American Air Power

New Strength Is Needed for National Security

8

W. Stuart Symington became the first Secretary of the Air Force on September 18, 1947. He had previously served as Assistant Secretary of War for Air when the AAF was a part of the War Department.

The Secretary was born on June 26, 1901, at Amherst, Mass., but was reared in Baltimore, Md. In World War I he enlisted in the Army as a private and, at seventeen, became one of the Army's youngest second lieutenants.

After the war, Mr. Symington completed his education at Yale and began his industrial experience. In 1932 he became president of a large corporation that produced stainless steel and in 1938 was made head of the Emerson Manufacturing Company.

Early in 1941 Mr. Symington became a consultant for the Army and in that same year built the world's largest airplane armament plant.

Mr. Symington's varied industrial experience and his company's war production record led to his appointment as Chairman of the Surplus Property Board in 1945. During the past three years, as Assistant Secretary of War for Air and as Secretary of the Air Force, he has demonstrated outstanding leadership ability in all matters pertaining to the air defense of our country.—THE EDITORS.

THE present Air Force consists of 337,000 uniformed and about 125,000 civilian personnel. It is equipped with a total of 10,800 aircraft in active status, including about 580 heavy bombers and 2,300 fighters. Backing up this force is a reserve of about 12,800 World War II aircraft usable at any time during the next two or three years to replace losses of planes due to current peacetime attrition or, in the event of war, caused by combat.

The President's Air Policy Commission, having thoroughly studied the problems of our Air Force, has made the following three recommendations:

1. The force in being must be increased from its present level to a minimum regular establishment of 70 groups (6,869 front-line aircraft), an Air National Guard of 27 groups (3,212 front-line aircraft), and an adequately equipped 34-group Air Reserve.

2. The level of procurement of new aircraft must be high enough to keep this force modern at all times.

3. An adequate reserve, now estimated at 8,100 aircraft, must be created and maintained in a proper state of modernization.

It is the conviction of the Commission that we must start now on such a program and complete it before the end of 1952.

It is highly improbable that the United Nations will develop, in time, the necessary authority to prevent another global war. The United States must therefore prepare now to defend itself for the possibility that war may come. Unable to count on absolute security under law, it must seek relative security under the protection of its own arms.

Relative security will be secured only in a policy of arming the United States so strongly that other nations will hesitate to attack us or our vital national interests. If we are attacked, we must be able to smash the assault at the earliest possible moment.

The issue of national security necessarily involves the maintenance of a strong Army, a strong Navy, and a strong Air Force. If we are to prevent the savage bombing of our cities, we must occupy and conduct offensive action from advanced bases strategically located and sufficiently close to the enemy's homeland. In addition, we must prevent the enemy from occupying bases from which to conduct offensive operations against us. The task of securing advanced bases rests, not on the Air Force alone, but on all three services.

Yet it would appear that the air arm today is incapable of offensive action for the simple reason that it is lacking in the essential units for effective combat. National security demands that we not only have a strong Army and Navy but also a strong Air Force. Indeed, new weapons and new strategic concepts of global war make it imperative that we be able at all times to defend the air approaches to our homes and factories.

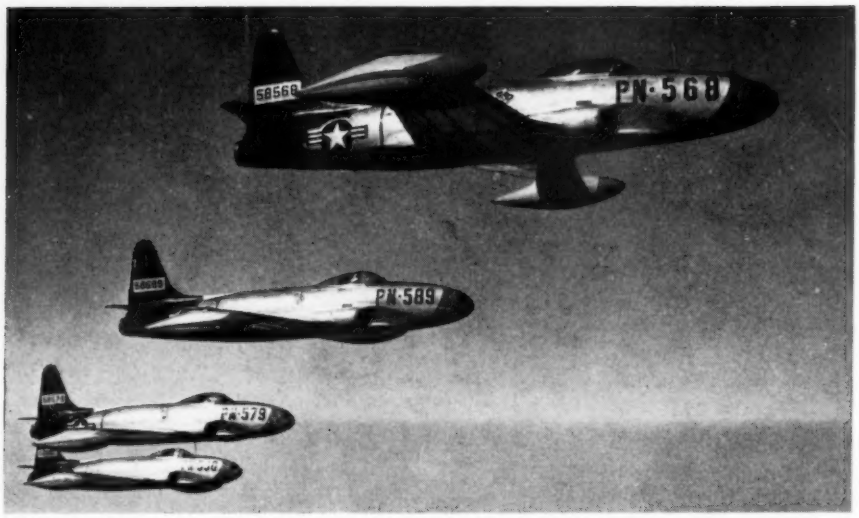
Today we have a monopoly on atomic weapons. In a few years, by the end of 1952, other nations will have atomic weapons in quantity and the equipment to deliver them in a sustained attack on our mainland.

If the Air Force is incapable of effective combat action today, how much greater will be our peril in 1952!

TAKING a highly realistic view of the air-power problem, it would seem that a major war during the next four years is unlikely. This opinion has been expressed to the President's Air Policy Commission by high military authorities. There is, however, such a thing as blundering into a war or being forced into a war, and we must be prepared for war in the immediate future.

During and after 1952 we need an even stronger force. An attack at that time would be extremely violent. What we must have and can support is a reasonably strong defensive establishment to minimize the enemy's blow, but above all a counteroffensive air establishment in being which will be so powerful that if an enemy does attack we will be able to retaliate with the utmost violence and to seize and hold advanced positions from which we can divert the destruction from our homeland to his.

It may be too late to start building a strong Air Force in 1952. It may be too late, at that time, to start building anything. But if we are endowed with courage, realism, and foresight, we can build today for tomorrow's security. If we are strong in 1952—strong on the ground, at sea, and in the air—we may be able to prevent an atomic and biological war in this hemisphere.



Our Vanishing Airmada

What Has Happened to the Wartime Air Force of 80,000 First-Line Airplanes?

by

John A. Giles

We should replace 100 per cent of our aircraft every 4½ years to remain well in advance of other nations.

GENERAL EISENHOWER, who told our Normandy invasion troops that "If you see any planes they will be ours," could not make that boast today.

For, although some top Air Force officials are inclined to be strangely more optimistic than they were a few months ago, the country's air power is far from adequate.

During the war we had the world's mightiest air force—an "airmada" of more than 2,400,000 men and 80,000 airplanes backed by an industry capable of producing 96,000 planes a year.

"A Futile Force"

Last spring the Air Force scraped together what they admitted to be "every operational B-29 in the country" for a demonstration of offensive air power over the eastern seaboard. Of the 130 planes ordered to participate, 28 failed to reach the rendezvous. The remainder, termed a "futile force" by their commander, Gen. George C. Kenney, carried through a program which caustic observers dismissed as "Operation Flop." Such was the condition of the Nation's air power.

And what worries the men who run the newly independent Department of the Air Force today is that the public, with memories of the days when vast fleets of planes hammered our enemies into submission, is inclined to visualize huge fleets of jet bombers upon the release of news that the first of such craft is undergoing taxi tests.

Be that as it may, man for man and plane for plane our Air Force is probably equal to anything in the world today, but it is not good enough for our own safety, according to the best aëronautical opinion.

Where are Our Bombers?

What, you may ask, has become of the 2,865 B-29's we had during the war? Dismissing the salient fact that the B-29, originated in the 'thirties and first built in 1941, is obsolescent, a total of 2,507 of them are in dead storage and to put them in combat condition would require: (1) from three to six months to get them ready to fly, if we had the ground crews; (2) twelve months to train the air crews, if we had the air crews; and (3) another six months to weld the groups into an adequate force to counterattack, if the Air Force had the authority and the money.

To make a long story short, our once magnificent Air Force is not ready for an atomic war.

It has made progress in the last year, yes. But it has a long way to go.

The Air Force has made steady progress—far surpassing the Army and Navy—in the matter of obtaining recruits, for which the service is justifiably proud. To reach the 337,000 enlisted strength of the 401,000-man program by June 1948, the USAF has been recruiting men at a rate exceeding its average monthly goal of 9,000. At year's end it had 335,000 officers and men—a rise from 301,000 in June 1947.

In the matter of airplanes during 1947, the Air Force received seventeen new types of aircraft, but in most cases —and this is most important—deliveries were confined to one or two experimental models.

Total Replacement

Our experts estimate that we must replace 100 per cent of our aircraft at least every 4½ years to remain tactically, strategically, and technologically in advance of other nations.

"Every plane and every engine which saw combat service during World War II was on the drawing board or in development prior to Pearl Harbor," Gen. Carl Spaatz, the Air Force Chief of Staff, points out.

Thus the Air Force must keep abreast of every technical development in new aircraft and, at the same time, maintain in constant readiness a fleet of existing craft, however obsolescent they may be, for the next war may come with a suddenness and destructiveness that would make Pearl Harbor seem like child's play.

Turning to the only potential enemy we have in the world today, it is interesting to note that only last May

Mr. Giles was public relations officer of the Fourteenth Naval District at Pearl Harbor during World War II and is now a military analyst in Washington, D. C.

Soviet Russia paraded one hundred jet fighters over Red Square and on last August 3rd held an air show at which at least eight types of jet aircraft were flown. Evidence indicates that Russian emphasis is being placed on jet types which the Germans had placed in operation and were developing prior to V-E Day.

While the Soviet Union probably remains predominantly a land power and the traditional concept of the army as the most important arm of defense and offense may well persist in the future, there have been significant changes in the composition of the Soviet armed forces in the last year, according to best Government sources.

Soviet Superiority

In 1946 the total Soviet armed forces exceeded ours by 98 per cent. Today their numerical superiority equals 134 per cent.

In September 1946, the Russian Air Force was manned by 23 per cent less personnel than the USAF. Today the Soviets are estimated to employ at least 33 per cent more personnel in their air force than we do.

Thus, while her relative numerical superiority in total forces has increased 36 per cent since the war, the relative increase of the Soviet Air Force personnel has amounted to 56 per cent, showing the trend away from the traditional concept of air power as an auxiliary arm to the ground forces.

The average civilian is apt to dismiss the Soviet Union's capacity to produce planes with any alacrity because of her great economic and industrial losses during the war. However, it is well to remember that she also possesses the capacity to perform radical and widespread reconstruction in short order.

In 1944 Russian factories alone produced better than 40,000 aircraft. Recently she was estimated to maintain some 14,000 planes in first-line combat units, many of them jet-propelled.

Our Postwar Program

An absolute minimum postwar program of fifty-five operational groups, fully manned and completely equipped, plus fifteen skeletonized groups, has been outlined for the USAF.

Additionally, opinion expressed at hearings of the President's Air Policy Commission favored an Air Force with a replacement of up to 5,000 aircraft annually to keep it abreast of the latest developments. This figure, however, is a long way from the production of which the aircraft industry is capable today. In January 1939, for instance, the production of military aircraft totaled 143.

The USAF itself, in a year-end review, said that "although total orders for 17 new types of aircraft constitute an air potential of more than 1,150 planes, only one, the Lockheed P-80B, has been produced in quantity. Deliveries of the other 16 types total less than 40 planes. Approximately 200 of the speedy P-80B's were delivered."

Qualitatively, the USAF is believed to be in a sound position. It has jet-propelled aircraft ranging from the P-80 fighter up the scale to the Northrop XB-35 "Flying Wing" bomber which recently made its initial test at Muroc Lake, Calif.

Weak in Air Power

It did not take the Air Policy Commission's report to convince Congress that we are dangerously weak in air power and that something had better be done about it. Legislative minds have grasped the paramount importance of air power in an atomic war for some time. In fact, Congress has its own agency, the Congressional Air Policy Board, which has been quietly going about looking into the situation.

But despite its intrinsically good intentions and despite the findings of boards and commissions, Congress faces an uphill fight in its efforts to do the right thing by air power because of the claims of other defense agencies and varied domestic and foreign problems.

Defense and Foreign Relief

In this connection, it is perhaps unfortunate that there should be a tendency to regard foreign relief and the military budgets as connected problems. The danger of such a tie-in, of course, is that major policies with respect to national defense might be kept hanging in the air until Congress makes up its mind on how far it will go toward helping Europe back on its feet. Several arguments are advanced for linking the two together. One is that a clear appraisal of the budgetary picture will be impossible until Congress decides how much of a slice overseas aid is going to require.

Also there has been a tendency on the part of Administration forces to take the position that success of the foreign-aid program will have a direct bearing on our military picture. On the other hand, many members of Congress believe that we should help Europe and build up our own defense at the same time.

In fact, most of the committee members who checked up on conditions in Europe last summer came back with the conviction that the Marshall Plan would merely involve pouring money down a rathole if we do not build up our military strength. They feel that Western Europe will lack the heart to rebuild itself if it knows that it faces possible totalitarian encroachment with no prospect of American air fleets to ward off such attacks and strike retaliatory blows.

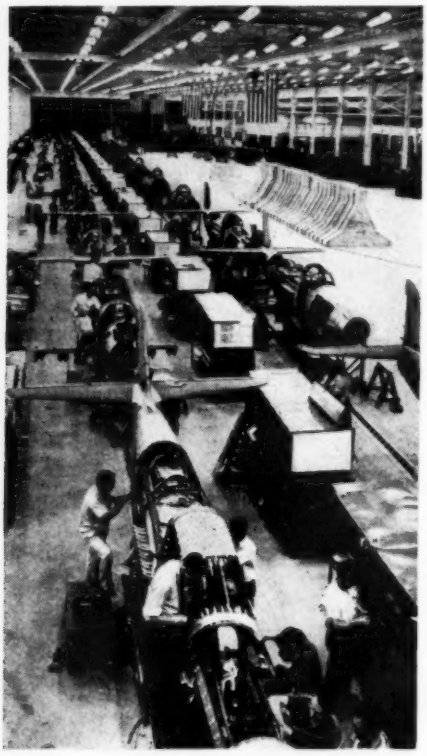
The Aviation Budget

Besides the risk of being caught in the cross fire of major policies, the military aviation budget will have to steer around many other pitfalls and snares. The mistaken impression as to the sav-

Air Force

The Northrop XB-35 heavy bomber presages the shape of things to come.

The squadrons of P-47's that once scourged Nazi personnel and transport are either nonexistent or skeletonized to the point where they are almost totally ineffectual.



The once vigorous aircraft industry has become anaemic and enfeebled by neglect.

Our once top-notch night interceptor, the Black Widow, is rapidly being outmoded by the developments in jet fighters and the swiftly changing aspects of air warfare.

ings that can be realized now that the armed forces have been unified is one such barrier. The Congressmen are as yet unaware, apparently, that the National Security Act in fact has not as yet brought about "unification" of the armed forces but rather "triplification" by the creation of a third arm—the USAF. Only recently have studies gotten underway to bring about eventual merging of some facilities and savings to the taxpayer.

To maintain and operate safely the force that the USAF has in mind would require an annual expenditure of $8,100,000,000 and the employment of 664,602 military and civilian personnel.

The Bureau of the Budget reports that actual over-all Government expenditures this fiscal year will total 37 billion dollars of which one third, or 10.4 billion, will be for national defense.

The current budget gave some $3,310,500,000 to the USAF in total direct and contract appropriations.

The USAF is quick to explain that "to remain strong and meet our obligations we must maturely understand that it will be expensive" and points out that it cost more than $30,000,000 to build the first B-36.

The Aircraft Industry

Undoubtedly the No. 1 requirement of the USAF is a virile aircraft manufacturing industry—one that can produce more than the one-third of our minimum required air strength which is being manufactured today.

And the aircraft industry is undeniably undergoing a major crisis. It is, in fact, facing operating losses of $50,000,000 a year, or worse.

Some sections of the industry are in relatively good shape; others notably are not. Tax carry-backs allowed by the Government will absorb a large part of last year's losses, but 1947 is the last year this will occur.

The industry's aëronautical scientists and production planners are being charged with the solution simultaneously of two of the most important problems of national defense—one long-range, one immediate.

The long-range problem calls for the development of all manner of weapons of the future. In the ultimate, this means robot guided missiles able to carry the atomic bomb accurately to targets more than 4,000 miles distant. Thus, an enemy's industries could be destroyed in hours instead of years.

Immediate Security

Immediate security is the other problem. It demands that the industry keep turning out piloted aircraft of all types which are faster and better in all respects than those of any other nation.

And the industry must keep in readiness for manufacturing thousands of planes on even shorter notice than ever before.

The question arose during the hearings of the President's Commission as to whether the Air Force should tell the builders what they want in the way of future aircraft or whether there should be open design competition.

From Commission questioning it appeared that competition was favored as a means of obtaining superior aircraft design for the United States.

The Air Force Department itself believes that a long-range program of a minimum of five years should be mapped out, "providing a stable influence in maintaining factories at a high peak of efficiency and modernization."

Signal Corps

The Problem of Inventions and the General Staff

by

Maj. Gen. J. F. C. Fuller

The weak link between science and the military is not lack of inventiveness but lack in priority of inventions.

NEARLY eighty years ago W. E. H. Lecky, in his "History of European Morals from Augustus to Charlemagne," wrote: "The causes which most disturbed or accelerated the normal progress of society in antiquity were the appearance of great men; in modern times they have been the appearance of great inventions."

Though this is patently true, it was not until the coming of the Industrial Revolution that inventive genius began to be placed on a coöperative footing, the inventor and the industrialist becoming mated.

A Static War

And though with the advent of the steamship, navies followed suit, collaboration between the soldier and the inventor was so painfully slow that in 1914, in spite of all belligerents being prepared for war, when war came it was not of the type any one of them expected—instead of being mobile it was static.

This was not due to lack of inventive genius between the years 1870 and 1914 but, as the events of the war proved, to lack of vision on the part of the general staffs and lack of appreciation of the powers of the improved weapons which had been introduced during the preceding forty years.

Opening as a conventional military conflict, World War I ended as a technical and industrial struggle in which factories were as important as armies, and during it the main military problem given the inventor was how to reinstate mobility.

The upshot was the invention of the tank and the rapid improvement of the airplane. Both not only defeated the bullet—the one by its armor and the other by flight—but, equally important, both defeated the road—the one by its ability to cross country in all directions and the other by its power to turn the air into a thoroughfare.

Here were facts which should have set vibrating in the mind of an imaginative general staff the vision of a new way of waging war—a vision which was about to penetrate the conventional tactical clouds when the war ended.

So convinced was I that the alliance between science and war was the leading military lesson of the conflict that on January 25, 1919, I wrote an official memorandum entitled "The Secret of Victory." It opened with the statement: "Tools, or weapons, if only the right ones can be discovered, form ninety-nine per cent of victory"—a statement purposely exaggerated in order to stimulate opposition and induce criticism.

My thesis was based on the incontrovertible fact that in modern times no army of fifty years before any selected date would have stood a dog's chance against the army existing at that date, and that in nearly every case the inventions which had led to the superiority of the latter were, if not in fact, at least in

General Fuller, noted British soldier-author, is one of the outstanding military analysts and historians of the present day. As an officer in World War I he was one of the foremost advocates of tank warfare and did much to mount the armored attacks that proved the value of the bulletproof track-laying vehicle. He is a Companion of the Bath, a Commander of the Order of the British Empire, and a Companion of the Distinguished Service Order.

theory or principle existent in the days of the former.

The Need for Clairvoyance

After exemplifying this, I came to my main point which was that inventions would remain militarily sterile unless the General Staff became clairvoyant. Inventors and designers existed in abundance, and science was more and more dominating the age. Therefore, all that was lacking was a General Staff, not only conversant with strategy, tactics, and logistics but of sufficient imagination to grasp how inventions could be adapted to the needs of war and what kind of novelties were required to enhance war power.

Working on the hypothesis that all rational demands could be met by science, I suggested that it was for the General Staff to set the imaginative pace, to create the demand, and for the inventor to supply it. Hitherto armies had waited for inventions; now they must generate ideas which would set inventors thinking.

Light As a Weapon

A case in point will illustrate this. Toward the close of World War I when I was engaged upon the tactical preparations for 1919 which, had the war continued, would have led to the introduction of the blitz attack twenty years earlier than was actually the case, a British naval officer, the late Comdr. Oscar de Thoren, suggested to me the use of light as a weapon.

"If on a dark night," he said, "you are traveling in a car with side lights on and you meet a car with powerful headlights burning, you either have to pull up or go slow. Though the driver of the oncoming car can see you, you cannot see him: all you see is a blaze of light which obscures everything behind it. Transfer this to the battlefield and you have a tactical revolution."

At once I realized that the project I was working on was obsolete because, following De Thoren's idea, by transferring the blitz attack from day to night it could be made many times more surprising, deadly, and less costly.

To cut a long story short, it was not until June 1940 that the British War Office decided to develop this suggestion, and the result was the production of the C.D.L. ("Canal Defense Light"—a verbal camouflage) consisting of an infantry tank fitted with a powerful projector which emitted a fan-shaped flickering beam of light and which was so heavily protected that only a direct hit by a 75-mm. armor-piercing shell could extinguish it.

By means of this invention the battle front could be converted into a blaze of blinding light behind which nothing could be seen, whereas the foreground and the enemy's position were brilliantly illuminated.

By the summer of 1944 two British brigades of five battalions of C.D.L's had been raised and trained, also two American armored groups, the 9th and 10th, each of three battalions. During the Normandy landing they were sent out to France, but for some as yet unexplained reason were never used, or if so in a very perfunctory way. Soon after their disembarkation most of the C.D.L. battalions were disbanded.

Considering that in practically all the fighting which followed the invasion of France, the Germans could only safely move by night, it is astonishing that the fullest use was not made of this formidable weapon. For instance, General Diestel, commanding the German 346th Infantry Division, said: "We never hurried in these movements [the retreat] because of the systematic and thoroughly organized tactics of the allies. When we had been thrown back during the day, we always knew that there would be a pause at night when the enemy would regroup for the next day's operations. It was these hours of darkness which enabled us to retire without suffering many casualties."

Imagination in the Field

The moral of this is that it does not matter how imaginative and inventive a General Staff is unless commanders in the field also possess some imagination, not forgetting a modicum of courage, much of the labor expended upon devising weapons and organizations of novel and astonishing powers will be wasted.

"The days of general-purpose armies are drawing to a close . . . Such organizations are static in conception and conservative in outlook and in a progressive age are normally completely out of date when most needed—in war. They are Jacks-of-all-trades and masters of none."

For argument's sake, suppose that the British General Staff had, in 1918, accepted De Thoren's idea and had methodically developed it during the postwar years. Suppose by 1940 they had built up, say, two or three C.D.L. divisions supported by two or three armored divisions, what would have been the surprise of the Germans had their daylight blitz attack on France, based on the British project for 1919, been met by a full-out blitz attack by night?

Catastrophic Surprise

Though no definite answer can be given to a hypothetical question, imagination suggests that it would have been catastrophic. Certainly as much so as the surprise the Germans won on borrowed tactics which enabled them to overrun Poland in 18 days, conquer Holland and the greater part of Belgium in 5, France in 35, Yugoslavia in 12, and Greece in 5.

Was this rapidity of conquest unforeseeable? Not to a clairvoyant mind. In 1936, in one of my books I wrote: "If the enemy's land forces cannot be stopped, then, even under existing conditions, it is possible for mechanized arms to overrun a country such as France, Germany, or Poland in a fortnight."

Again, did it really need one naval disaster after another to prove that the battleship was obsolescent? In the face of rising air power, in 1937 it seemed so patent to me that, in another book, I wrote: "Bomb power is the key, because air-carried bombs vastly outrange gun-fired shells." Therefore, "it follows that naval warfare will be very different from what it was in 1914-1918." Surely, this should have been obvious to a blind bat, yet it was not!

When we turn to World War II, unlike the opening phase of World War I, we find each belligerent only too eager to rope in the scientist and inventor. The result was a veritable spate of inventions but for the greater part uncoördinated. Stimulated by the demands of each service and undirected by a single brain which could see the war as a whole, they led at times to a vast misuse of man power and resources.

Of the more revolutionary of these inventions, the development of radar is of particular interest because it was the direct outcome of collaboration between scientists and the General Staff. Some years previous to the war at a meeting between British scientists and Air Staff officers, Viscount Swinton, then Secretary of State for Air, asked the question: "What would be the greatest revolution in air warfare?"

Whereupon an Air Staff officer replied: "I think the greatest revolution would be if we could know where an aircraft was a quarter of an hour before it got here."

"That seized all our imaginations," writes Lord Swinton, "and the more we thought of it the greater we saw would be the advantages."

The problem was given to Robert Watson-Watt to solve. This he did in 1937 with remarkable success, and thereby revolutionized air tactics. It is highly probable that without radar the R.A.F. would have lost the Battle of Britain.

Glancing back on the whole war, it now becomes clearly apparent that the weak link between science and war was not lack of inventiveness but lack in priority of inventions. And in the main this was due to the direction of the war being in the hands of Combined General Staffs, in contradistinction to a single War Staff. Each was composed of officers who, having served in either the navy, army, or air force, were unable to transcend their departmental outlooks. This, I think, was particularly true of British and American Air Force officers who for years had preached the doctrine that wars could be won by air power alone.

It was the antagonism between the priorities which was at the bottom of the trouble—too many heads and no single brain. Each Combined General Staff was in fact a Cerberus or a Hydra.

What Is THE Problem?

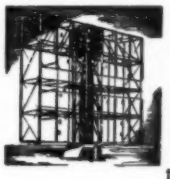
Had there been one brain—that is, could the staff chiefs have divorced themselves from their individual and departmental points of view—the first question this brain would have asked itself was: "What is *the* problem?" Not merely "What is *my* problem?" but what is *the* problem of each belligerent?" Then it would have been seen that each problem was governed by a number of special conditions—geographical position, resources, speed, etc.

In attempting to understand what I mean by "*the* problem," the reader must bear in mind that what follows is merely illustrative of the answer and is in no way complete, because in the space at my disposal I cannot do more than touch the fringe of two of *the* problems.

In Germany, centrally placed as she was, the problem was to avoid a two-front war, to overrun Western Europe, including Britain—the center of gravity of the war—in a minimum time, and then, when once free from the danger of attack in the West, to right about face and, by defeating the Russian armies, either dissolve the Soviet Union or force Russia to peace.

"Fighting forces must be integrated as well as concentrated if the maximum mobility and striking power are to be obtained."

On the one hand there was the historic difficulty of crossing a narrow stretch of water—the English Channel—and on the other the historic difficulty of crossing a vast stretch of land—the Russian steppes. Should the crossing of the first be long delayed, England might become too strong to warrant invasion. If the Russian armies could not be prevented retiring into their vastnesses, the strain placed on German communications might be so great that, stretched out like a piece of elastic, the invasion might snap.



Therefore, long before the war, it should have been apparent to the German Combined General Staff that the crucial problem was a twofold one: How to cross the English Channel and, next, how to cross the plains of Russia in a minimum time. It was a problem of mobility.

What happened? Instead of concentrating on building specially designed landing craft and cross-country supply vehicles and asking science to assist in solving these two problems, the German Combined General Staff took up the war where it had been dropped in 1918. Being better prepared to fight a 1919 war than any of their enemies, their armies were eminently successful so long as 1919 conditions prevailed.

But after the fall of France these conditions no longer existed, for then the German armies were faced by the historic problem—the crossing of the English Channel which, had they possessed the means of crossing it, might well have brought the war in the West to a decisive conclusion before 1940 was out. Lacking these means, whatever might happen in the air, the invasion was bunkered, and the center of gravity of the war remained intact.

In Russia, the German initial advance to Smolensk—two-thirds of the way to Moscow—in twenty-five days was as rapid as had been the race over Holland, Belgium, and France. At Smolensk a halt of nearly six weeks occurred. Why?

Though there were several reasons, one stands out clearly. The German armored forces outran their communications, because in the main their supply columns consisted of wheeled vehicles which could not keep pace with a cross-country advance.

Had these columns been composed of cross-country vehicles, this difficulty would have been overcome, and the high probability is that, had it been, Moscow would have been occupied before winter set in.

The Anglo-American Problem

Next, I will turn to the Anglo-American problem. In Europe it was very similar to the German western problem and in the Pacific to the German eastern problem. On the one hand it was to cross the English Channel and on the other to cross vast sea instead of vast land spaces. It was also a problem of mobility and therefore of transportation—landing craft and supply aircraft in place of cross-country vehicles.

Should the crossing of the Atlantic and Channel be delayed, Russia might be forced out of the war, an event which might well result in such an increase of German strength in Western Europe that an invasion of the Continent would become impracticable.

In the Pacific, if the Japanese navy and air force could not be prevented from turning the vastness of the Pacific into a maneuvering area, as the Russians were able to do with their steppes, the war in the Far East might go on for years.

Therefore, if not before the war, any-

how shortly after it started it should have been apparent that the two main problems were the crossing of the English Channel and the crossing of the Pacific in the minimum of time.

Bombers, Not Landing Craft

What happened? Instead of concentrating on building landing craft and transport aircraft, the British and American Combined General Staffs put their main effort into building bombing aircraft. Yet, ultimately, it was landing craft and transport aircraft and not bombers which above all other means were the decisive factors.

Important though it may have been, though I doubt it, the destruction of German industry and civil morale was not *the* problem. *The* problem was the occupation and not the obliteration of Germany. *The* problem is always a problem of mobility, and destruction is never more than *a* problem of how to enhance or impede mobility.

Between 1942 and the end of the war a superabundance of evidence shows that the so-called strategic bombing of Central Europe and Japan, by absorbing so vast a quantity of man power and materials, actually delayed the development of mobility which could and would have been enhanced had a substantial portion of these resources been allotted to the development of the means of mobility.

Looking back on the war as a whole, its most obvious lesson—ever new to the military mind—was the ancient one that fighting forces must be integrated as well as concentrated if maximum mobility and striking power are to be obtained. No single arm or weapon won the war, or could have won the war, not excluding the atomic bomb.

But whereas concentration is a physical process, integration should start as a mental process in the mind of the General Staff. And unless it does so the principle of economy of force will inevitably be violated.

The days of general-purpose armies are drawing to a close, if not already closed. Such organizations are static in conception and conservative in outlook and in a progressive age are normally completely out of date when most needed—in war. They are Jacks-of-all-trades and masters of none.

In contradistinction to them, three of the most remarkable organizations were the creation of a sea-army under Admiral Nimitz to defeat the vastness of the Pacific; the creation of an air-army under General Slim to overcome the jungles of Burma, and the creation of a triphibious force, accompanied by its ports of disembarkation, under General Eisenhower to span the English Channel.

It is in these operations—now normal and no longer exceptional—that the scientist, technician, and inventor step into the breach which nearly always exists between plan, means, and execution, and by their inventive genius span the tactical and administrative gaps. Never once did they fail to do so.

Therefore in this scientific age it is the planners—the General Staff—which should most concern us. They also must become scientifically minded for, as Thomas Henry Huxley once affirmed, science is nothing other than common sense. Once a war is ended the single duty of a General Staff is mentally, if not physically, to prepare for the next war; indeed, it has no other *raison d'être*.

"Imagination, Specification, Invention: in these three words lurks the whole problem and its answer."

In England, after World War I, it was postulated that there would be no major conflicts for ten years. This was the poppy cake which sent the British Cerberus—the Combined Chiefs of Staff—to sleep. This time, and after the most calamitous war since the barbarians burst into Europe in the fourth and fifth centuries, what do we read? "In framing their plans the (British) service heads are working on the assumption that there will be no major war in the foreseeable future." A conclusion "based on an analysis of the world political, economic, and military situation" (!). Should this be true, then the poppy cake of 1919 has been doubly dosed with opium.

Unity of Thought

Also, should it be true, it logically follows that the General Staffs of all nations accepting this preposterous hypothesis will have ample time wherein to reform themselves, and of all reforms the most vital is to esablish unity of thought within themselves. Without it there can be no true unity of command in the field. The second, and, indeed, equally important reform, is the cultivation of a fertile and vivid imagination.

War a Political Act

Nevertheless, in planning for war, the General Staff officer is not a free agent. He is the instrument of his government, because war is a political act. Therefore, unless the government has a clear-cut idea of what its political aim is, its General Staff will have the greatest difficulty in preparing for the type of war which will most economically and effectively create the military conditions which will render the political aim attainable.

Should the political aim be purely destructive, as were the British and American aims in the recent war, then, perforce, the General Staff must think in the terms of destruction—in bigger and bigger bombs.

Should it, however, be constructive—that is, should the Government concerned have taken General Sherman's words to heart, that "the legitimate object of war is a more perfect peace"—then the General Staff must think in very different terms; for a world reduced to rubble is clearly no solution to the problem of winning the peace.

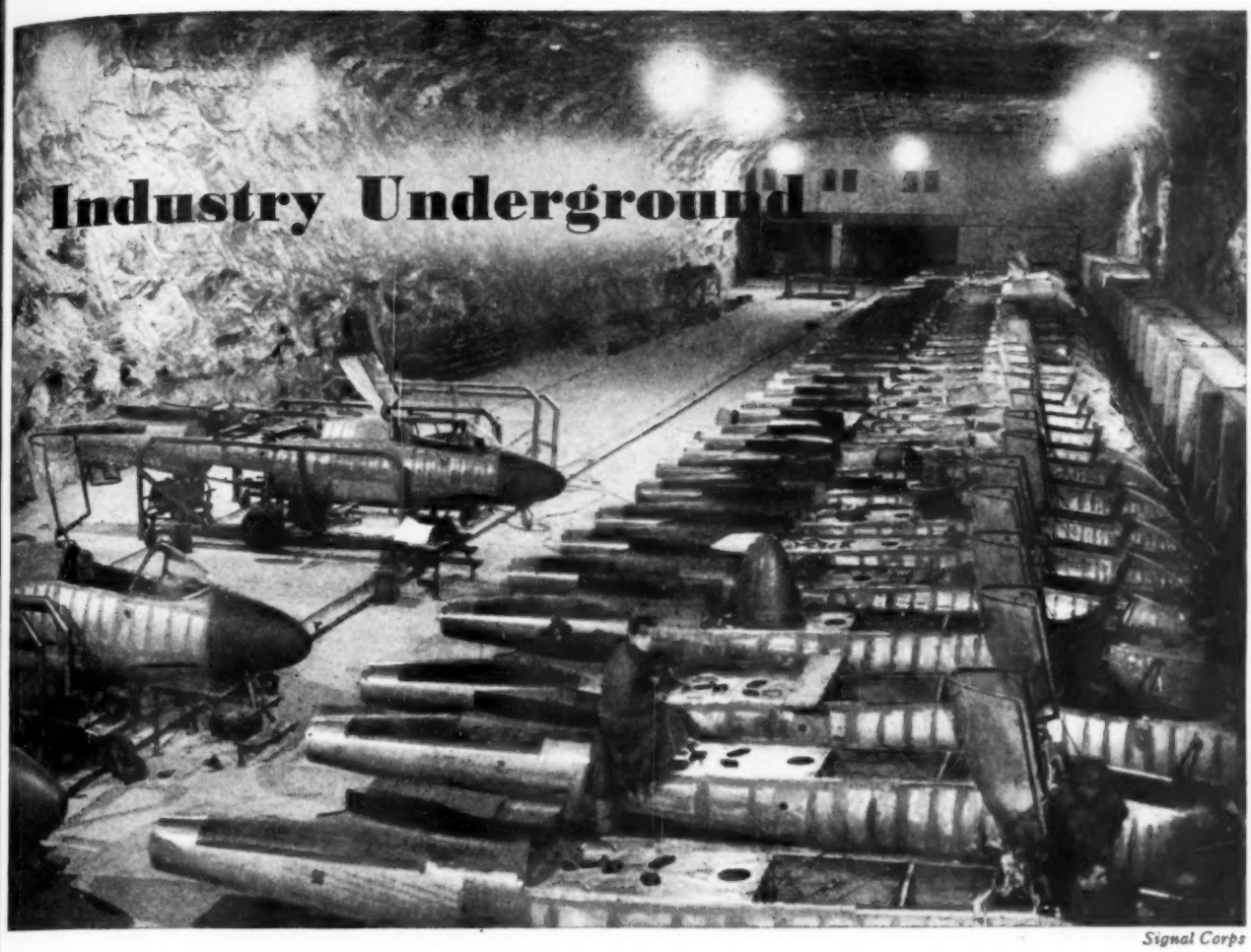
Occupation Not Obliteration

Should a constructive war be decided upon, and in a sane world there can be no other type, then the General Staff must realize that the strategic object in war is not obliteration but instead the occupation of the enemy's country; that the linch-pin of all its thoughts is mobility; and that destruction is actually a hindrance unless it enhances mobility.

With this pivotal idea in its mind, it must plan its next war, and it must plan it both for the present and for the future—that is for fighting instruments as they are, and fighting instruments as they may have to be within foreseeable circumstances.

The General Staff must, therefore, be an organ comparable to the management of any great business. An organ concerned not only with maintenance and discipline but above all with service, and to serve it must keep itself up to date.

Imagination, Specification, Invention: in these three words lurks the whole problem and its answer.



Signal Corps

U. S. Industry Must Not Be the Pearl Harbor of Tomorrow

by

Ira W. MacBride

Any future aggressor will regard American productive capacity as the prime obstacle to world conquest.

WHAT are the facts on underground sites for American industry?

This question is being asked by many U.S. industrialists who look at their factories and remember the rubble seen during a trip to Europe or in newsreel reports of the destruction of enemy industrial facilities during the past war.

Although proven facts concerning the feasibility of underground protection against the menace of modern and future weapons of war are few, it is possible to develop logical conclusions from available information. Our knowledge of the subject to date primarily consists of the data gathered from the experiences of the Germans and Japanese in their war-improvised construction. Other knowledge is being compiled by our National Military Establishment.

Under the direction of the Munitions Board, the Corps of Engineers has completed a survey of representative types of underground sites in the United States. The Engineers have also contracted with the construction firm of Guy B. Panero to ascertain the cost and feasibility of underground sites. In accomplishing this mission, the firm will design two underground industrial facilities. In addition, the armed services are responsible for studies within their special areas and for operational purposes.

War Still a Possibility

Current international distrust indicates that war is still a possibility in our world. Modern warfare, with its devastating weapons along with the fact that such warfare is fought in greater part with materials, makes it apparent that greater defenses than those now existing are required in the protection of the facilities and personnel engaged in the production of the materials for war.

The ability of our Air Force to penetrate the air defenses of Germany and Japan proved that aërial fighter barriers and antiaircraft barrages will not stop a modern aërial striking force.

These facts compel a demand for the maximum protection of installations, industrial facilities, and personnel at **home.**

Mr. MacBride is an author and military analyst.

With the realization that underground protection, if feasible, must be achieved in peacetime, the first question is: "How can it be done?"

The suggestion that we place our industry and man power beneath the earth for their protection is a vast assumption. Because of the magnitude of such a measure, it cannot be advocated that American industry go underground as an outright move. Nor can it be suggested that the Government subsidize such protection. Either would be disasterous to our economy.

Consequently, the movement underground must be cautious and evolutionary. Commercial practicality and industrial planning must go hand in glove with military planning for the defense of industry in an emergency.

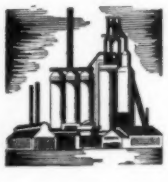
Bury New Facilities

Protection must be achieved gradually, probably consisting of dispersing and burying new critical facilities when constructed. When existing facilities deteriorate to a renewal point, replacement should be made with dispersed or subsurface facilities.

Gradual decentralization and underground protection will nullify the impact of such moves on the economy of the country. Consequently, over-all planning and construction would necessitate subtle reconstruction to eliminate the hardship that quick action would create.

However, dispersed and protected industrial might is essential to our national security in the event that universal peace is not achieved. The problems involved must be tackled now, and sensible planning should be undertaken by our people, industry, and Government.

One of the first steps taken in the United States toward planning underground sites for storage and factory facilities was the survey by the Corps of Engineers. The purpose of the survey was to determine the availability of underground sites for industrial facilities and all possible relative data concerned in the great problem of subsurface utilization—structure, strength, accessibility, space, humidity, etc.



Although the report of the survey has not been made public, it is understood that it covered some 1,000 representative types of underground sites. It is evident that, contrary to the popular conception, natural caves do not make the best sites for these purposes. Natural twists and variations in levels would make a great amount of reconstruction necessary. Another detrimental factor in caves is the high humidity which is harmful to stored materials and costly to control.

Jap underground production also suffered from the lack of free and simple transport. Interdiction of highways and railroads leading to underground plants retarded production by obstructing the receipt of materials and delivery of finished goods. Destruction of electric power would have had the same effect.

In contrast with the utilization of natural sites, constructed underground facilities are much more advantageous. They can be built according to specifications based on need in relation to the latest military knowledge of the subject and with ideally selected accessibility.

Indication of the superiority of constructed facilities was found in the Jap experience of pressing the second and third basements of a department store into service for machining propeller parts. In contrast with tunnel and cave plants, the basements offered no unusual operational problems, were clean, light, dry, and efficient. Furthermore, no external evidence of the activity was visible to photo interpreters.

Evaluating the Underground

In evaluating the necessity and value of the earth as protection, it is essential to start at the point where the underground first assumed importance.

Militarily, the underground has been used practicably for centuries. Many of our modern fortresses and installations, primarily those of stable defense artillery, have subterranean spaces for storage, magazine, and shelter purposes, all of which have proven value. Corregidor's great stand is definitely a monument to the value of the underground in the era just past as were the Catacombs a monument to that value in antiquity. That value is still existent in military installations wherein the problems of transportation are not extensively involved, such as in the case of a fortified island base.

In the Pacific phase of the late war, the Japs utilized the underground wherever possible in the islands. The accumulative defense tenacity of these measures added to the time extent of that phase of the war. Each such facility proved a veritable fortress and took all the power our forces could muster to obliterate it.

In Germany, underground sites were utilized extensively and there, too, proved valuable. At Neuhof, Germany, the salt mine was used for the storage of medical and chemical-warfare supplies. Hundreds of tons of supplies were stored there, and small trains with battery motor power were used efficiently for transportation through the tunnels. Two speedy elevators were used for communication with the surface.

Salt mines in this country have been suggested as ideal industrial sites. But when one considers the corrosive effects of salt, the inclination is to limit them to storage of noncorrosive materials. The Nazis also used part of the salt mine for grenade-filling operations.

Other Nations Less Cautious

Rumor and fact give evidence that other nations are faster and less cautious than the United States in converting the underground for defense. Great Britain is reported to be enlarging upon facilities constructed during the war. Another country, it is rumored, pressed prisoner-of-war labor into the construction of the largest underground airfield in the world. Located in a commanding area, this field has great air-striking potential.

With such a background, subterranean facilities become a concrete element in the science of modern warfare requiring, among many other things, an extensive study of the geophysical aspects, moral and psychological effects on personnel, effectiveness of below-surface sites against specific weapons, the efficient interweaving of sites into the national industrial pattern, costs, and the extent to which American industry must or should go underground.

In order for an underground plant to be efficient as well as protective, it must have normal and expeditive accessibility for both personnel and materials. One of the great errors committed by the Germans was in commandeering underground mines with limited means of physical communication with the surface. In such cases, as much as half a shift was absorbed in the transportation of workers to and from the surface.

Similar problems rule out the extensive use of abandoned mines as practical underground facilities, aside from limited storage and shelter purposes. Upon abandonment, most of the physical communications systems are removed along with much of the internal protective construction such as shoring and similar support. Subsequent deterioration and collapse require extensive and costly reconstruction to achieve rather limited space.

Abandoned quarries have been suggested as being highly adaptable for the purpose, but these, too, are limited because of economy factors. Building booms and normal material expansion would complicate underground planning to an embarrassing degree, although planned quarrying might overcome some of the limitations. Such planned operations would cut the cost for a site immeasurably.

Signal Corps

The Germans used this salt mine to store medical and chemical-warfare supplies.

Constructed Sites

Relatively, constructed subterranean facilities offer the best solution to the general problem. For such construction, soft-stone areas, primarily limestone, are the most adequate and adaptable for the purpose. Areas of this and similar stone are located in every part of the U.S., thus offering, in part, a solution to the general problem of location.

In construction of below-surface facilities, the problem of depth is of major importance. How deep must one go to become immune from specific weapons? Apparently, from the type of weapons now used, the depth need not be great, and it is not likely that weapons of the future will have much greater penetrability.

Progress is currently being made to determine the proper depth. Recently the Corps of Engineers announced a project to test the power of huge explosive charges. Figuring 320,000 pounds of TNT as being equivalent to one-fifth the rated power of the atomic bomb used in World War II and using subsurface structures of the types which might be built underground the engineers will determine structural damage due to earth shock.

In addition, available statistics on surface penetration and explosive effect of existing missiles will provide a key to both the depth needed and an estimate of the penetrability of future missiles.

Ventilation systems now used could be vulnerable points in the impregnability of subterranean installations. Radioactive materials might be able to traverse a ventilation system as also could chemical weapons. However, proper plating could protect a facility from radioactivity, and the sealing of ventilation systems, using emergency oxygen during attack periods together with proper decontamination, could negate such attacks. Better still would be a ventilating system composite within the subsurface facility with a completely artificial air source and a stand-by oxygen supply for emergencies caused by breakdown or power failure.

Psychological Effects

In the realm of morale, underground facilities offer a complex but not insurmountable problem. Maintaining good morale among underground workers should not be too difficult. There is little difference between below-surface factories and many of our modern surface plants which are completely sealed from natural atmosphere and dependent on artificial lighting and mechanical ventilation.

Psychologically, an underground worker will have to be made to feel the strength of his surroundings with all its accompanying assurances. Extensive health measures similar to those used by the Navy for its submarine personnel will have to be employed to assure the worker that his health is not being impaired by his "gopher" activity.

Location of underground sites should go hand in glove with decentralization of U.S. industry which must also be considered in defense planning. Corporations now might consider the value of strategically locating a new facility away from vital areas and, while doing this, also consider the feasibility of going underground.

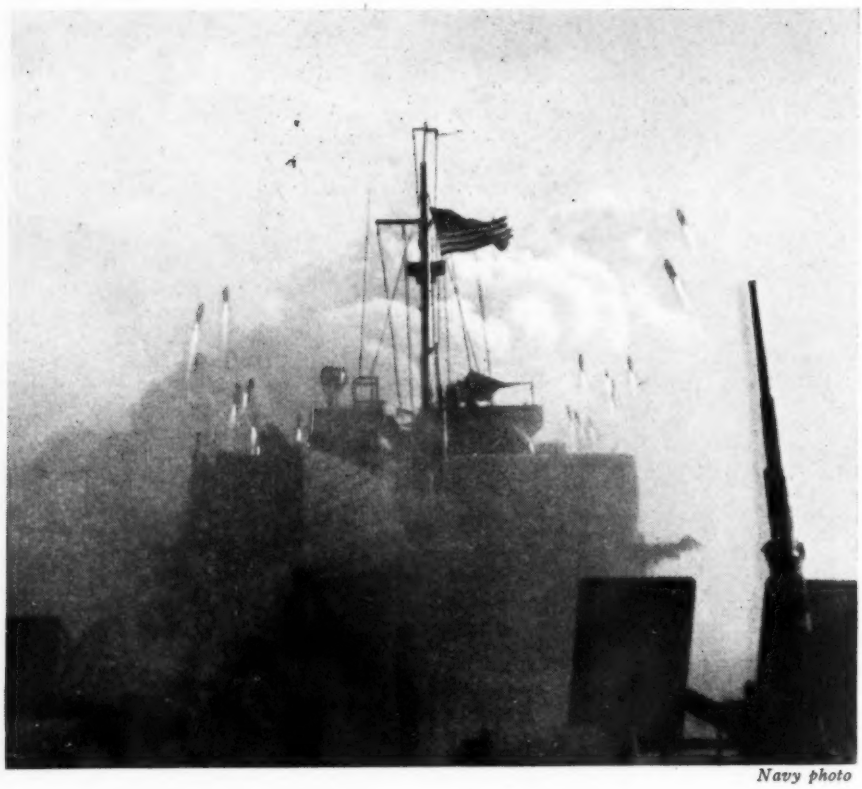
At this point it can be recognized that all industries do not lend themselves to underground placement. Shipyards, certain types of mills, and many other industries cannot be drastically converted from their present situations without serious curtailment of productivity.

However, the mere fact that some of our industrial strength is so protected permits greater surface protection to be allotted to facilities not covered by the earth. Protection similar to that used in the German submarine pens could be constructed for partial protection of surface facilities. Addition of an effective antiaircraft or antimissile system around such facilities would provide added protection.

Future Plans

It is obvious that the whole country cannot go underground and that the luxury of such protection probably will be afforded only to those facilities whose destruction during an emergency would create a detrimental chain reaction throughout our whole industrial effort.

No program for subsidizing the construction of underground industrial installations by the Government is anticipated at this time, and it would seem that the burial of a plant will be at the discretion of the owner. But such a responsibility might not be too hard a burden if, as has been estimated, the maintenance of an underground plant is cheaper than maintenance of a surface facility.



Navy photo

The New Navy

This Atomic Age Requires New Answers to Old Naval Problems

by

Edward J. Evans

Advanced strides made recently by engineers, scientists, and designers in the development of ships, aircraft, and ordnance have been tremendous.

WHAT will be the shape of the Navy of the future? That has been a question bandied about by real and armchair naval strategists, industrialists, and ex-Navy men in every part of the country.

At the atomic finish of the war, several schools of thought predicted the end of surface fleets while new super-submarines capable of serving as aircraft carriers and troop transports, armed with rockets, guided missiles, and powered by atomic energy, would constitute the navy of the new age.

Others foresaw huge fleets of stratospheric rocket ships of "Buck Rogers" design striking the enemy with the speed and ferocity of meteors.

These are extreme views, at least for the present, but the advances of science are fast bringing to actuality many of the once-dreamed-of elements now required for the composition of new and more powerful battle fleets.

Now that the immediate urgency of war no longer exists, the forging of a new Navy may take years. Nevertheless it is important to take full account of the great strides made recently by scientists and engineers in the development of new and improved ships, aircraft, and ordnance.

Already the Navy is achieving the realization of theories developed from wartime experimentation and discovery.

Mr. Evans was formerly a staff writer for the Marine Corps magazine, *Leatherneck*, and is now a military analyst for service and scientific journals.

New and larger submarines are under construction that embody such improvements as new power units that permit cruising for distances hitherto not believed possible. New designs for undersea transports and freighters and weapons giving them deadlier firepower than ever before are also under way.

New Surface Craft

Surface battle craft, too, are coming in for revolutionary changes in design, armament, and maneuverability. The startling destructive energy of the atom bomb has been converted to a new kind of power under man's control. The atom-pile engine of the future will permit warships to operate almost independently of vulnerable advanced bases.

Increasing use of electronics in long-range detection, navigation, and fire control will raise efficiency to an all-time high. But currently the most spectacular developments have been in ordnance such as rockets, superautomatic guns, and the variable-time (VT) fuze.

Plans and specifications are now being drawn up in the Navy's Bureau of Ships for a new line of future battle craft. The present focal point of this planning is on the partly completed battleship KENTUCKY and the battle cruiser HAWAII, slated to become our first electronic-controlled, guided-missile vessels. It is highly possible that all guns larger than 8-inch will be declared obsolete and disappear along with their heavy turrets and control towers, thus giving the ships a lower, smoother silhouette.

In announcing this change in plans for the warships, Admiral Cochrane declared: "The design studies now being made for the KENTUCKY and HAWAII, together with the development of guided missiles, will lead to a revolution in the striking power of Navy fighting ships."

Engineering Problems

Many problems confront engineers and designers in adapting huge vessels to the use of guided missiles and providing the fire-control systems necessary for such long-range weapons. Conversion of several types of smaller craft to rocket ships during the war, however, laid the groundwork for much that has to be done.

The very great possibility of using atomic power for propulsion will permit important reductions in dead weight, but in the early stages of appli-

cation it is quite possible that a conventional heat-transfer system will be used: boilers and turbines for converting atomic energy into shaft-turning power. Direct-drive atom power in some form or other should logically follow in due course.

Since the ordnance of these new guided-missile battleships is the primary reason for their development, it is important to know the steps by which they came into being. In every past war, scientific research has leaped ahead to open new channels, only to lose headway and drift with the tide of each succeeding postwar "economy" program. So it was with our rocket research.

When the Japanese Navy struck at Pearl Harbor we had not one type of rocket in service use, although the Russians had made spectacular use of them in early combat.

It was only by extensive British aid and coöperation that we were able to overcome our handicap in this field. By the end of the war the Navy alone was using up rockets in action at the rate of $100,000,000 worth a month. Varied and powerful, they ranged all the way from the 2-inch shoulder-fired bazooka rocket to the ponderous "Tiny Tim"—a 12-inch, 1,200-pound "job" packing the wallop of a 16-inch naval gun.

Rockets and Jets

Although related in principle, rockets generally differ from jet propulsion in theory of operation. The rocket carries within itself the oxygen necessary for combustion of its fuel, while the jet motor must depend upon the oxygen in the atmosphere of the earth. It is for this reason that the rocket has predominated as a projectile.

Once rocket propellent charges had been perfected and standardized, production was simplified by the use of standard artillery shells as war heads for the rocket motor. It was in this manner that the 5-inch naval projectile became a 6-foot, 140-pound rocket, with the very apt name of "Holy Moses" evoked by its awing performance.

Having no recoil, rockets require only light launching tubes or troughs to give them direction; yet they are usually heavier than artillery shells of equivalent size and effectiveness. Early rockets used light launching racks and had simple fin stabilizers on the arrow principle. Later models in use at the end of the war were designed with multiple nozzles set at an angle to give the rocket the spin that an artillery shell gets from rifling.

Rocket Ships

Rockets proved their effectiveness and accuracy many times in land and air combat. Therefore it was inevitable that the rocket should become a seagoing weapon. The most practicable vessel then at hand was the LSM, and these ships became the first naval rocket fleet, using fin-stabilized rockets in banks of fixed-position racks.

Later, at Okinawa, a flotilla of twelve new LSM(R)'s appeared. In 12 weeks of fighting, these small ships, bristling with remote-control automatic launchers, poured more than 30,000 rounds of 5-inch spinner rockets into enemy fortifications.

As research continued, the spinner-type projectiles came to predominate through ease of handling and high accuracy. A series of 5-inch spinner rockets was developed with ranges varying from 1,250 to 5,000 yards. All weighed fifty pounds, were thirty-two inches long, and were usable in the standard automatic launcher.

While rockets, jet propulsion, and guided missiles will ultimately play the major rôles in warfare, the Navy has not been neglecting the standard weapons. The new twin 3-inch 70-caliber gun is destined to replace the 20- and 40-mm. guns as antiaircraft weapons. It throws out a faster and heavier stream of projectiles than any of its predecessors. Completely new in design, this 3-inch gun is equipped with a radar fire-control system by which it picks up and tracks the target, computes range and corrections, then loads and fires—all automatically.

Also fully automatic and operating in much the same manner is the new 8-inch triple turret which functions without a crew from ammunition room to gun chamber, loading VT-fuzed shells at all angles of elevation. Long secret, the variable-time (VT) fuze was one of the most remarkable additions to the firepower of the Navy.

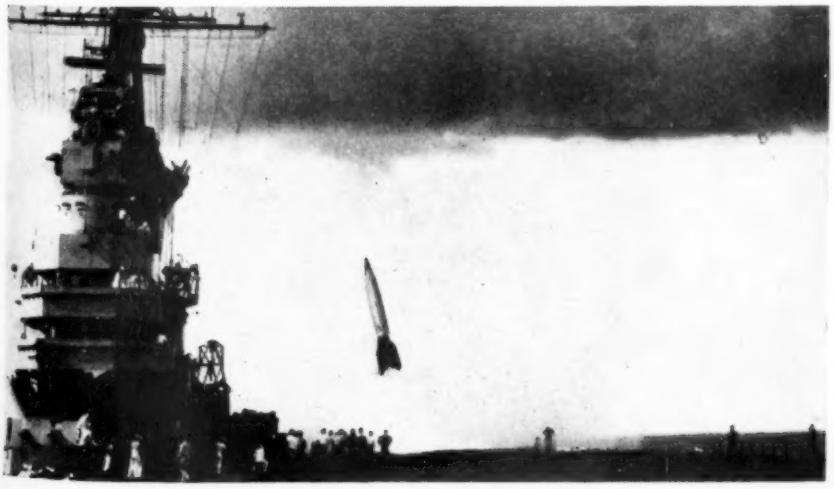
The VT Fuze

The heart of the VT fuze is an extremely rugged little 5-tube radio sending and receiving set fitted into the nose of a projectile. Its brain is a tiny vacuum tube that sends out electromagnetic waves at the rate of 186,000 miles a second—the speed of light. These pulses are reflected by land masses, bodies of water, and metal objects.

When a VT-fuzed projectile passes within seventy feet of the target the reflected magnetic waves act on a fuze circuit to a trigger switch setting off the explosive charge.

With the use of VT fuzes, the old fuze-cutting mechanisms and their inherent errors are eliminated, making possible maximum results at split-second speeds.

With fast, long-range fleets of surface ships and submarines armed with powerful automatic rocket weapons and guided missiles able to detect and destroy their targets, the Navy is just embarking upon a new and highly adventurous era. The day of wooden ships and iron men may be long gone, but in its place is one of mechanical marvels and scientific men who sail the seas in defense of the Nation.



Experiments in firing V-2 rockets from an aircraft carrier without interfering with air operations proved the feasability of launching guided missiles from naval vessels.

Bombs versus German Industry

Destruction of the Giant Krupp Works at Essen

by

Leo A. Codd

The devastation of Europe, wrought by the tools of war produced by industry, is an object lesson to the world in its search for peace in this atomic age.

ORDNANCE—the guns, tanks, bombs, trucks, ammunition—did a most thorough job in World War II. We who know the complexities of American mass production will vouch for the truth of this statement as far as overcoming the difficulties of manufacture and logistics is concerned. But only those individuals who have had a full opportunity to see what these fighting implements did to Europe—especially the effect of bombardment on the industrial power of Germany—can comprehend the thoroughness of the damage done by ordnance. Modern ordnance is the death knell of modern industrial strength!

During November 1948 I was privileged to be among a group of American editors and publishers who were invited by the Secretary of the Army, Hon. Kenneth C. Royall, and Lieut. Gen. Lucius D. Clay, Military Governor of Germany, to visit Western Germany. Our party was given every opportunity to study the military, economic, political, and social conditions in the American and British Zones of that country.

I have already reported to members of the American Ordnance Association some of the broader conclusions arising from this European visit (see the Association's monthly newsletter *The Common Defense,* No. 87, January 1948). Readers of this journal may be interested in some further observations which I propose to present from time to time in these pages.

Don't Underestimate Air Power

The first and most far-reaching point to remember about modern weapons in so far as we here in the United States of America are concerned is: never underestimate the devastating, destructive effect of bombing in modern warfare. With this point in mind and from an analysis of the bombing effects of modern air power, we can well get some idea of what would happen here at home if we are ever subjected to major air attack. The destruction wrought by bombs in Germany is so complete and so vast that the best way to gain some comprehension of it would be to take some one case and see in it a good sample of what applies to most of the others—and could well apply here.

Krupp Background

I propose in this article to tell you about the damage done to what had become one of the world's foremost industrial producers, the gigantic Krupp plant at Essen in the Ruhr. Today, that mammoth establishment is a shambles. We would do well to consider it in all its implications—past and present—for it is an outstanding example of the destruction wrought by twentieth-century total warfare.

First, let us consider the background of the organization, for Krupp is no modern development. Its history goes back to the late sixteenth century. In 1587 Arndt Krupp, a Rhineland merchant, arrived in Essen and became a member of the Guild of Smiths. This was the foundation of the trade which the family followed for generations.

Early in the nineteenth century, on September 20, 1811, to be exact, Friedrich Krupp (1787-1826) founded the first cast steel works (Gusstahlfabrik) "for the manufacture of English cast steel and all articles made thereof."

In 1826, Alfred Krupp (1812-1887) at the age of 14 became head of the organization upon the death of his father, Friedrich, and shortly thereafter the company entered upon its long record of high-quality steel production.

On March 1, 1844, the first quotation for a gun barrel made of cast steel was submitted to the Prussian Ministry of War. But it was not until three years later, in the summer of 1847, that the first gun barrel made of cast steel was supplied to the Prussian Ordnance Inspecting Commission in Berlin.

Steel Products

Krupp has frequently been represented in American and English literature as being exclusively an armament-manufacturing concern. This, of course, is far from the truth. Exactly one hundred years ago Krupp embarked upon the production of railway axles and springs made of cast steel. This was followed by the manufacture of weldless steel tires for railroad car wheels. Indeed, the financial results of this invention carried the business along, and enabled it to finance that portion of the works required to meet the uncertain needs of the German Army for ordnance production. The Krupp trademark showing three interlaced rings, adopted in 1875, refers to these weldless tires. In 1863 the company produced its first cast-steel railway car wheels.

In the meantime, the development of ordnance for the German Government had progressed. In 1851, Krupp produced a 6-pounder steel-barreled gun and a cast-steel ingot weighing 4,500 pounds which was exhibited at the World's Fair in London that year.

In 1867, the Krupp 30.5-cm. (12-inch) 1,000-pounder gun, the only gun of this type ever made, was shown at the World's Fair in Paris. This time a cast-steel ingot of 88,160 pounds was exhibited. In 1871, the company produced a 4-cm. (1.6-inch) antiballoon gun for use in the siege of Paris. In 1879, the company demonstrated its 44-cm. (17.3-inch) gun for coast defense.

In 1887, when Friedrich Alfred Krupp became head of the company upon the death of his father, Alfred, the Krupp organization underwent its greatest expansion. An armor plate rolling mill was put into operation in 1890. In 1897, the first two blast furnaces were installed in the plant at Rheinhausen. In 1902, the company undertook the operation of a giant shipyard at Kiel.

Krupp was converted into a joint stock company in 1903 with a capitalization of 160,000,000 Reichsmarks. All shares were held by Bertha Krupp who was born in 1886 and who, in 1906, married Gustav von Bohlen und Halbach (born 1870). The latter, pursuant to a decree of Emperor Wilhelm II, shared the name of Krupp before his own. He became chairman of the company in 1909.

This is the first of a series of articles by the editor of ORDNANCE following a lengthy on-the-scene study of military and economic conditions in Western Germany.

Construction of the first submarine, U-1, was begun at Germaniawerft, a Krupp shipyard, in 1907. The fifty-thousandth cast-steel gun was delivered in 1911. At the siege of Liége, in 1914, the first Krupp 42-cm. (16.5-inch) gun mounted on mobile carriage came into action. In 1916, the merchant submarine DEUTSCHLAND, built at the Germaniawerft, was sent to America where, having eluded the British blockade, she quietly arrived on July 9, 1916. In 1918, the three long-range "Paris guns" (maximum range nearly 80 miles, caliber 8.26 inches) designed and produced by Krupp were used in the bombardment of Paris.

Commercial Machinery Made

But armament production became only a minor part of Krupp operations. Even during World War II, the manufacture of commercial machinery and metal products went forward. A locomotive factory was established in 1916 from which first deliveries of Krupp locomotives were made December 6, 1919. By 1934, 1,500 locomotives had been produced in this plant and 2,000 by 1939.

In the midst of World War II a further change was made in the financial structure of the company. On December 15, 1943, the joint stock company was converted back to a private firm, and it was reëstablished as a family enterprise. The eldest son of Bertha Krupp, Alfred Krupp von Bohlen und Halbach, born in 1907, became the sole proprietor. He was arrested at Villa Hügel, the Krupp family home at Essen, by American paratroopers on April 10, 1945. He is now on trial with other Krupp officials charged with crimes against humanity before the American War Crimes Court at Nuremberg.

Thus it can be seen that the organization and history of the company resemble that of many similar large manufacturing concerns in the United States except for the fact that under our traditional American system nearly all ordnance production in time of peace is carried on in Government arsenals while under the European—including the British—systems private companies are subsidized for this purpose. Otherwise there is striking similarity.

Ten Major Works

The Gusstahlfabrik had ten major works at Essen for the production of heavy machinery, motor repair, mine operation, etc. There were eight other plants throughout Germany for the production of all manner of metalware, including machine tools and equipment required by heavy industry. In Germany, Krupp held directly or through subsidiaries a controlling interest (51 per cent or more) in 110 companies, an interest varying from 25 to 50 per cent in 15 companies, and investments below 25 per cent in 127 companies.

Outside Germany, Krupp had industrial investments in nearly every European company from Belgium to Bulgaria, from Norway to Italy. It held a controlling interest in 41 foreign companies, a 25 to 50 per cent interest in 7 such, and an interest below 25 per cent in 18. The entire enterprise at home and abroad included coal mines, ore mines, shipbuilding and shipping, aircraft engines, trucks, etc., etc.

The volume of business done in the fiscal year 1938-1939 amounted to 760,000,000 Reichsmarks of which 472,000,000 Reichsmarks (62 per cent) was derived from commercial products manufactured for the home market and 58,000,000 Reichsmarks (8 per

cent) of such production for export. The production of war materials in that year accounted for 230,000,000 Reichsmarks (30 per cent). It is interesting to note that of the latter category only two per cent was for export.

In talking with old employees of the company I gained the impression that few concerns anywhere surpassed Krupp in good employee relations.

The employment figures both in peace and in war are very revealing. On September 30, 1938, there were 123,408 employees in the entire Krupp organization; 55,655 of these were at work at the Gusstahlfabrik in Essen. On the same date in 1939 there were 139,259 in the organization; of these 63,775 were at Gusstahlfabrik. A year later—at the end of the first year of World War II—the over-all figure for the entire concern was 149,290, of whom 70,164 were at Essen.

This modern giant, this leader of German industrial and military power, has been blown to smithereens! The first air raid on the giant Krupp plant at Essen took place May 10, 1940. The first heavy night raid did not come until nearly three years later, on March 5, 1943. Heavy daylight raids began October 25, 1944. The last and heaviest daylight raid was on March 11, 1945.

Throughout the war 884 air-raid warnings were sounded. As a result, approximately 4,000,000 man hours were lost due to the first 626 of these warnings alone. In all, there were 55 air-raid attacks, 16 of which were large-scale raids, and 4 of these latter were daylight raids.

The total weight of bombs dropped on the Essen plant was 2,100 tons consisting in all of about 115,000 bombs (3,500 high-explosive, 95,000 incendiary, 17,000 phosphorus incendiary).

Bomb Casualties

The results, in addition to the nearly complete destruction of the Essen plants, were 180 German employees and 285 foreign workers killed. Some 300 employees were injured. Casualties suffered by the city of Essen were approximately 7,500 killed, which number does not include many thousands of "missing persons" of whom there are no recorded figures.

The ruins defy description. All that remains are crazy-looking walls and chimneys, twisted girders, craters into which machinery has tumbled, burnt-out shells of structures. All else is rubble. It looks as though a combined earthquake, tornado, cyclone, and tidal wave had hit the place and kept hitting it over and over again. Strangely enough, the main office building in the center of the works was not completely destroyed. Throughout the debris are the silent evidences of much of the machinery and equipment in production at the time of the last major blow. Huge vertical boring mills, armor plate bending presses, gigantic forges and hammers, and dozens of cranes are in the topsy-turvy of the tangled mass.

Much of Germany's railroad industry and facilities were smashed by the Allied air armada, thus hamstringing the Nazi war machine and delaying her peacetime recovery.

At present, the affairs of Krupp and what is left of the plant are under the jurisdiction of the British Control authorities. Under Article I of Military Government Law 52, a controller was appointed for this plant on November 16, 1945, and all property of the Krupp organization in the British Zone came under his management. For all the information I have used in this article I am indebted to the office of the controller.

British Objectives

The principal objectives of the British control officials are:

1. To obtain full information regarding all assets of the Krupp firm.

2. To act as custodian of all the property of Krupp in the British Zone and to take the necessary steps to prevent dissipation of the assets.

3. To recommend to the Krupp advisory board such action as may be necessary to ensure the complete disintegration of the Krupp financial control.

The Borbeck open-hearth smelting installations and rolling mills which were relatively undamaged are being dismantled and shipped to Russia. This plant was said to have been the most modern of its kind in Europe. It was built after World War I and started production in May 1929.

The ultimate fate of Gusstahlfabrik is a subject yet to be decided by the governments of the United States, Britain, France, and Russia.

An Object Lesson

Many object lessons rise out of these ruins, but none is more compelling for us here in the United States of America than this: We will deserve to perish if we let it happen here. *The one certain way to make sure that our industrial power is not destroyed by enemy bombs is to insist that the defense forces of the United States—science, industry, Army, Navy, Air Force—be kept at maximum efficiency at all times.*

Correlary to this conclusion is one that is even more far-reaching: the nation in modern war which does not have control of the air is defeated even before war begins.

The ruins of the giant German industrial machine, and of Krupp in particular, have proved beyond doubt that any nation which does not have control of the air *instantly and constantly* had best quickly decide between the only two alternatives there are—prompt surrender or complete obliteration.

The Coast Guard

Since 1790 the men of the United States Coast Guard have created a tradition of courage and devotion to duty in peace and war that is unsurpassed. In peace the Coast Guard serves under the Treasury Department as a federal police force to protect life and property on the seas and navigable waters of the United States. But, as part of the armed forces, it has served, under the direction of the Navy Department, in almost every war in our history.

Coast Guard Academy cadets on a practice cruise climb the shrouds of the training ship EAGLE.

The EAGLE, right, once a Nazi vessel and one of the few remaining square-riggers, is used by the Coast Guard for training cadets from its Academy.

Some old ways are still the best. These boots are getting practice on a lifeboat.

Training in rescue is constant. Above is a CG crash boat for saving downed fliers.

The Coast Guard cutter EASTWIND is one of several ice-breaking vessels specially designed and built for smashing a pathway through thick ice found in polar waters.

The Coast Guard aviation wing has greatly e
such as this PBM-5 fly speedily to the rescue o

The icebreaker NORTHWIND led the Byrd expedition through the icepacks of the Antarctic seas.

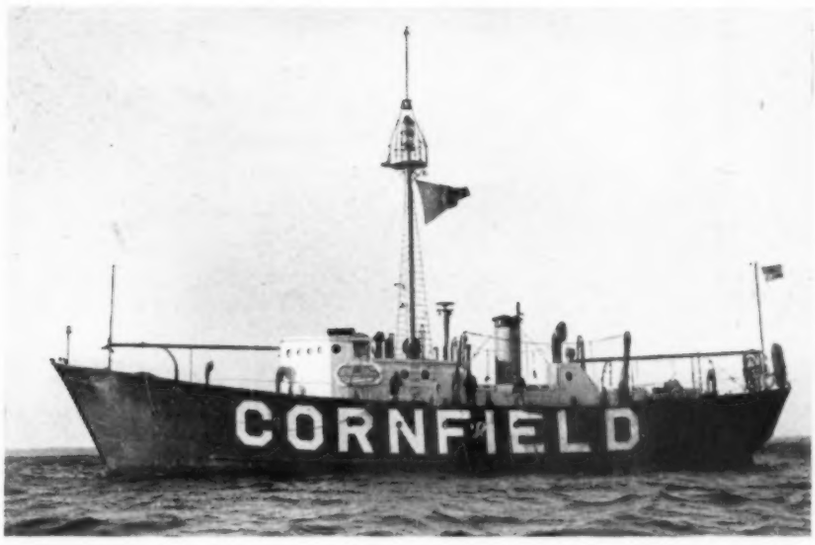
The lifeboat attached under the wing of this CG plane can be dropped by parachute to succor people in danger.

During the war, coastg
were often accompani

A small boat from a Coast Guard cutter approaches an iceberg off the Greenland coast that has been eroded by wind and sea.

This CG helicopter is shown rescuing a survivor of an airliner which crash-landed in the wilds of Newfoundland.

greatly extended the scope of CG operations. Planes e rescue of ships and men who might otherwise be lost.

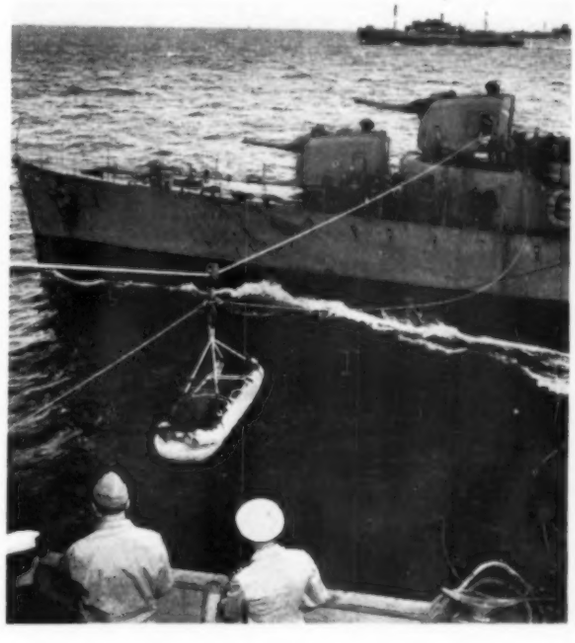


Off Cornfield Point, Conn., the lightship bearing that name takes her stand. The Coast Guard maintains 36,879 aids to navigation in territorial waters of the U. S.

ar, coastguardsmen patrolling the beaches ccompanied by highly trained war dogs.

From the deck of a cutter, icebergs look small and harmless. Actually two-thirds of their bulk is under water, and it is the job of the CG to ward shipping from these deadly menaces.

Coast Guardsmen, left, attain mastery of small boats by constant drill both at sea and in port. The legendary history of the CG was made in these small craft. Right, a wounded crew member of a Navy destroyer is transferred to a CG transport while both ships are underway, a task requiring great skill.



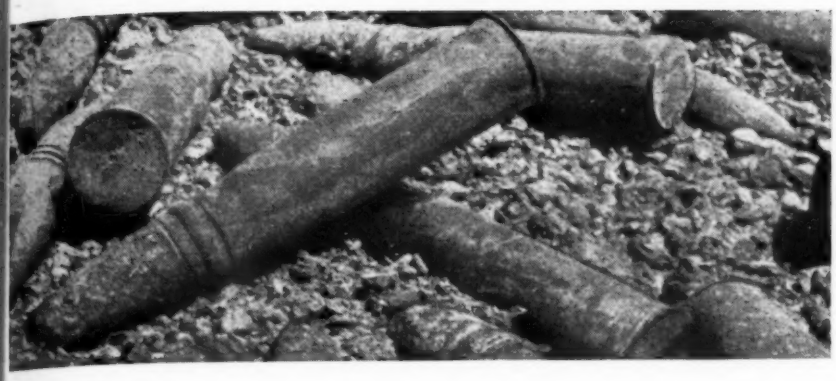
An officer takes a bearing as his CG cutter shepherds a merchant convoy bringing food and ammunition to our troops overseas.

Coast Guardsmen and ships must venture out in any kind of weather to bring aid and to protect life and property.

A flotilla of troop-packed LST's manned by Coast Guardsmen were brought safely to the beaches of Pacific islands.

The Coast Guard manned many of the landing craft that carried American infantrymen and supplies to Normandy beaches.

This coastguardsman directs incoming LST's to their beaching positions in an attack against Sarmi, Dutch New Guinea.



Danger — Live Ammo!

Ordnance Bomb Disposal Experts Hunt Explosive Duds and War Souvenirs

by

Lieut. Thomas A. Mort

By ceaseless search and public education the Army has saved the lives of many unwary people in the Hawaiian Islands

ON the Fourth of July, 1946, four boys who were fishing from a small island near Oahu, Hawaiian Islands, discovered a 75-mm. shell which had been washed upon the beach. One of the boys picked it up, inspected it, and dropped it. The resulting explosion killed one boy and badly injured the other three.

The island from which these boys were fishing was a former artillery practice target. It had been cleared of duds in January 1946 and released from Army control. Forces of erosion had, however, continued to unearth shells and duds along the shore after the area had been released.

Col. R. W. Daniels, Ordnance Officer for Army Forces, Middle Pacific, recognizing the need to prevent more of these accidents, initiated an extensive publicity and operations campaign to clear all impact areas and to present to the public the part they must play to make the campaign successful. "Operation Dud," as it was known to those who participated in it, was the combined effort of Ordnance and the Engineers to clear Oahu of all dangerous explosives.

Two-Phase Operation

This operation was divided into two phases. One phase was aimed at clearing missiles from all areas that were under Army control during the war. This was carried out by the Corps of Engineers. The second phase, handled by Ordnance, was the removal of explosive souvenirs and duds which had found their way into civilian hands.

To be cleared under the first phase were 13 large impact areas on Oahu and on other small islands and rocks once used as targets lying from 100 yards to 1½ miles off shore. No problems were encountered in searching the areas on Oahu itself. The searchers formed a line, shoulder to shoulder, and walked forward searching the ground visually. Any object which appeared to be a dud was marked by the searchers and later investigated by bomb-disposal men who followed behind. Any explosive item was detonated in place.

The search of the rocks and small islands off shore was a little more difficult. Many shells and bombs had missed the target and were lying on the ocean floor in five to thirty feet of water. Using 2½-ton amphibious trucks as diving platforms, Engineer and Ordnance bomb-disposal men searched the ocean bottom along most of the windward Oahu shoreline, a distance of thirty-five miles. This phase of the operation took 6 months; 19 areas were cleared and 977 high-explosive missiles were destroyed.

Publicity Campaign

The other phase of Operation Dud was carried out concurrently. A well-planned publicity campaign under the direction of Col. J. H. Hinrichs, the Deputy Ordnance Officer, was aimed at making the public "dud conscious." Newspaper and radio programs asked the people to turn in souvenir ammunition to Army bomb-disposal men and to notify Ordnance of any suspicious objects washing up on the beach or found in the fields and forests.

Military and civilian police acted as reconnaissance agents and, where very dangerous items were found, cleared the area until bomb-disposal personnel arrived. Their prompt and accurate reporting made it possible for the bomb-disposal officer to assign the correct priority to each call.

In the 5 months, August through December 1946, over 200 telephone calls were received at bomb-disposal headquarters requesting men to investigate duds. More than 275 explosive items were recovered. Among these was a Japanese floating mine which washed ashore at Koko Head beach and was immediately reported to Army authorities by civilian police.

The Ordnance unit that bore the brunt of the cleanup task was the 212th Ordnance Bomb Disposal Squad. It has now received the Meritorious Service Unit Plaque for the energy and initiative displayed in accomplishing so much with so few men.

Still Much To Be Done

It is planned to continue the publicity campaign and the policing and repolicing of former impact areas. There is still much to be done, and the people of Oahu are aware of this. Sixty-five reports of suspicious objects were received at the bomb-disposal office during March and April of last year. In fifty-six cases, live duds were recovered. The schedule for policing of ranges and impact areas reaches far into 1948. If it is humanly possible to remove every dud and explosive souvenir from the island of Oahu, the Army will do it.

Lieutenant Mort is an officer of the 212th Ordnance Bomb Disposal Squad stationed in Hawaii.

For Eminent Service We Salute These Industry-Ordnance Leaders

W. H. Worrilow

A. E. Walker

Quincy Bent

Vice Adm. G. F. Hussey

C. B. Thomas

W. H. Worrilow, president of Lebanon Steel Foundry, Lebanon, Pa., played an important part in the mobilization of industry in the Philadelphia Ordnance District during World War II. His company was among the principal producers of steel products for use in ordnance equipment.

A. E. Walker is president of the National Supply Company, Pittsburgh, Pa. Since his graduation from the University of Michigan he has devoted his entire life to heavy industry in the United States. For many years he has been a guiding light in Ordnance activities in the Pittsburgh area.

Quincy Bent is synonomous with the steel industry, having devoted forty-seven years of his business life to that industry's development. Throughout the period he had marked influence on the metallurgical development of ordnance. In World War II he was chairman of two committees of the War Production Board. He retired as vice-president of Pittsburgh Steel, November 1, 1947.

Vice Adm. George F. Hussey, World War II Chief of the Navy's Bureau of Ordnance, has joined the staff of the American Standards Association as administrative head. There he will continue to serve the Nation by directing the coöperative efforts of industry, consumers, and government in the vital problems of standardization.

C. B. Thomas, general purchasing agent for Sears, Roebuck and Company, was general manager of Lordstown Ordnance Depot which was operated by Lordstown Depot Management, Inc., operating subsidiary of Sears. He was instrumental in installing far-reaching improvements for scheduling requisitions and for the control of production costs.

S. J. Cort, formerly general manager of Bethlehem Steel's Sparrows Point, Maryland, plant is now vice-president in charge of steel division operations of that company. Of tremendous importance to the national defense in peace and in war, the plant under his direction has conducted huge development, particularly in the light steels.

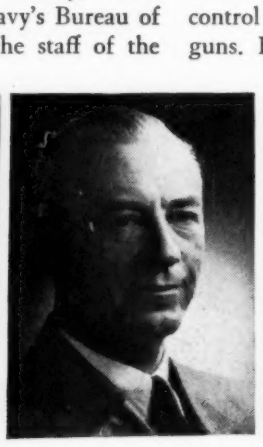
Dr. L. T. E. Thompson has performed outstanding service in the field of underwater ballistics, aircraft fire-control systems for bombs, rockets, and guns. He helped organize the Naval Ordnance development center at Inyokern, Calif., where he is now technical director of the Naval Ordnance Test Station.

Col. Frank J. Atwood, distinguished Ordnance officer and former chief of the Rochester Ordnance District, is vice-president of Remington-Rand, Inc., and director of procurement, inventory control, and traffic. Active in the Empire Post, American Ordnance Association, he also took a leading part in the outstanding record established by the Industry-Ordnance team in World War II.

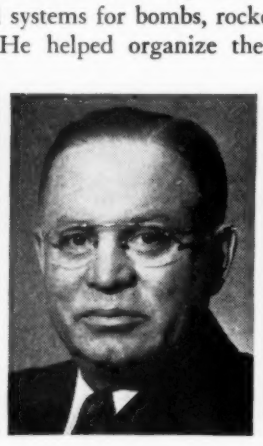
Dr. R. D. Bennett, electrical engineer, was on active duty with the Navy in 1940 and helped build up the Naval Ordnance Laboratory, participating in its wartime activities. He aided in planning the Laboratory's new establishment at White Oak, Md., where he now is technical director.

Dr. Thomas H. Johnson was former chief of the Ballistic Measurements Laboratory and associate director of the Ballistic Research Laboratories, Aberdeen Proving Ground, Md. He now heads the physics section at the Brookhaven National Laboratories. He is best known for his work on cosmic rays.

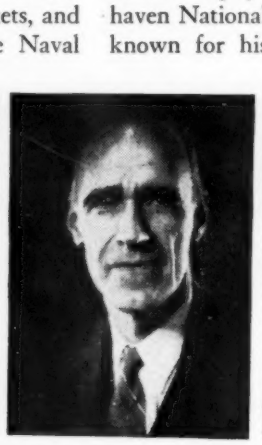
S. J. Cort



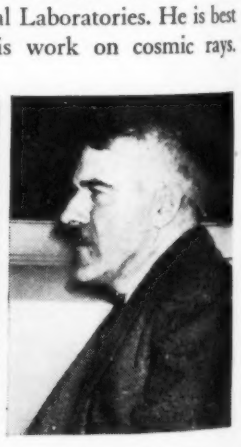
Dr. L. T. E. Thompson



Col. F. J. Atwood



Dr. R. D. Bennett



Dr. T. H. Johnson

Genesis of the War Rocket—Part I

Rockets in History

These Weapons from the Past Were Developed to Amazing Efficiency

by

F. W. F. Gleason

With origins in ancient times, rocket development showed great potency and promise until overshadowed by gunnery

IT is certain that the reaction-propulsion principle was known by the classic Greeks and that they employed it to operate certain scientific toys. The suggestion is occasionally made that the people of India may have used some form of the war rocket as early as 200 or 300 B.C. For an historical starting point, however, we must turn to 1232 A.D. In that year the Chinese, defending Pien-king against the Mongols, used "fire arrows" on the attackers. As no mention was ever made of the bow, catapult, or other mechanical means for launching, and as the Chinese had previously used rocket-like fireworks, it is generally accepted that this was the first recorded use of the rocket as a weapon of war.

The idea seems to have traveled to Arabia and India and thence to Europe. Muratori, an Italian historian who furnishes the next specific date, states that in 1379 a war rocket was used to fire a defensive tower at the Isle of Chiozza with important results. Timur (Tamerlane) employed rockets in the great battles which marked the siege of Delhi in 1399.

Early European Records

Early mention of European use of the weapon is found in the writings of Albertus Magnus and Roger Bacon. Many accounts appeared in Europe from 1300 to 1500 devoted to various plans for the use of war rockets, but actual use in battle seems to have been limited to rather haphazard attempts to frighten the enemy or to ignite wooden structures.

Research in this period is complicated by the use, in both Arabian and European writings, of expressions that were quite interchangeable for bombs, incendiary arrows, or rockets. In 1550, rockets with stabilizing fins in place of the tail stick were described, as were underwater rockets in 1610.

Even as a shadow may foretell events, the birth on May 20, 1772, of William Congreve foreshadowed the great rocket activities of the following sixty years. Opposing Hyder Ali, Sultan of Mysore, in the first Mahratta War of 1780-1784, the British made their first serious contact with the strange weapon, and in 1789, Monro published in London an account of this use.

As Congreve's father was an official of the British Ordnance Corps, the 17-year-old youth doubtless knew of this book. However, it was a reaction to the next series of events which definitely brought the younger Congreve into rocket work and changed the course of ordnance history.

In 1792, the Mahratta Wars resumed. Tippo Sahib had succeeded his father and, at the siege of Seringapatam, he employed rockets with increased effect. By 1799 his rocket corps had expanded to 5,000 men, using rockets of from 6 to 12 pounds guided by 10-foot poles. Though not very accurate, they ranged more than 1,000 yards. The bamboo missiles were hurled in clouds at the British troops again besieging Seringapatam, inflicting numerous casualties and causing great confusion.

Congreve's Interest

By 1801 or 1802, detailed accounts of the siege reached London, and Congreve, then an enthusiastic ordnance officer of thirty years, was so impressed that he soon took the first step in the course which was to make his name synonymous with "rocket" for more than a century.

By 1803, fate had made Congreve's father the comptroller of the Royal Laboratory at Woolwich. There, a few years before, a General Desaguliers had conducted unsuccessful experiments with war rockets. Despite this failure, Congreve considered that any weapon which had shown such success in oriental hands could be vastly improved with the resources of nineteenth-century England.

In 1804 he started his first actual experiments, purchasing the largest skyrockets available in London which were found to give a range of 500 to 600 yards. There was, of course, little difficulty in obtaining the facilities of the Royal Laboratory, and the range of even these pyrotechnic rockets was soon extended to 1,500 yards.

He next had larger rockets made at Woolwich Arsenal and it was here, in 1805, that his first "war rocket" was exhibited. By the fall of that year, at the time of the first—and unsuccessful—attempt upon Boulogne, Congreve's 6-pounder, paper-cased rockets were giving ranges of 2,000 yards.

Mr. Gleason is an ordnance historian and a student of military affairs. Illustrations on pages 327 and 329 were drawn by John G. Stees and appeared in Neil H. Swanson's "The Perilous Fight" published by Farrar & Rinehart.

Napoleon was even then gathering barges at Boulogne for an invasion attempt, and after the failure of the first attack (for which the weather was largely to blame) Congreve redoubled his efforts to improve the destructive effects of his missiles. The paper case was replaced with sheet iron, the tail stick was shortened from 25 to 15 feet, and the rocket's weight was increased over fivefold to 32 pounds. Its war head carried 7 pounds of incendiary mixture—pitch, saltpeter, tallow, and gunpowder. This new 32-pounder averaged 3,000 yards' range.

On October 6, 1806, there occurred the first use of the new rocket in battle, and it was the first time in history that any such use was recorded with clarity and detail. Eighteen ship's boats (forty feet in length) were each fitted with a single discharger consisting of a trough atop a 12-foot ladder that was reared against the boat's foremast (which substituted for the bipod ordinarily used). Elevation and depression was secured through use of the mast's halyards which raised and lowered the trough.

These boats discharged 200 rockets into the port of Boulogne in some thirty minutes. Though the French made light of the results, serious fires occurred in the town and on the waterfront. In view of this success, it is impossible to explain why the attack was not renewed.

The war head of an incendiary rocket is shown (top, above) filled with inflammable material. The parachute flare, below, was carried aloft in a 42-pounder rocket and then discharged.

The war rocket is a startling example of a weapon brought to a state of great effectiveness and then forgotten, only to be resurrected in a later era and hailed as a new "discovery." In the hope that other developments in weapons progress may not likewise be forgotten, ORDNANCE here presents the first part of a complete study of the war rocket. It will be concluded in the May-June issue.—THE EDITORS.

Incendiaries

The next year (1807) Copenhagen, harboring a large French fleet, was almost destroyed by fire through the mass discharge of some 25,000 Congreve rockets. In 1809, a novel use was made of the new weapon: affixed to the rigging of the fire ships attacking the French fleet in Basque Roads were 1,200 incendiary rockets. Later, the city of Danzig was compelled to surrender on November 27, 1813, when the city's food stores were destroyed by the fire of 32-pounder rockets.

While the British fleet was thus achieving success after success with the new engine of destruction, little use had been made of it in land engagements. Wellington had been very unfavorably impressed by rockets, noting that they would occasionally explode in the discharger or even turn in flight with disastrous results to friendly troops. This opposition prevented their use in the armies under personal command of the Iron Duke.

However, on October 16-19, 1813, the British Rocket Brigade was the only body of English troops at the great "Battle of the Nations" at Leipzig. Colonel Himes, in his "Origins of Artillery," states that "a French infantry brigade in the village of Paunsdorf, unable to withstand the well-directed fire [of rockets], fell into confusion and began to retreat and ultimately surrendered to the [British] Rocket Brigade."

This successful use of rocket troops at such a crucial victory seems to have broken the ice. The brigade fought at practically all subsequent Napoleonic battles, distinguishing itself at Waterloo.

Although Gen. C. Mercer, in his 1870 edition of the "Journal of the Waterloo Campaign," states that Wellington ordered Capt. E. C. Whinyates to exchange his rockets for field guns. Mercer also records that during the retreat from Quatre Bras rockets were used, one destroying a French battery.

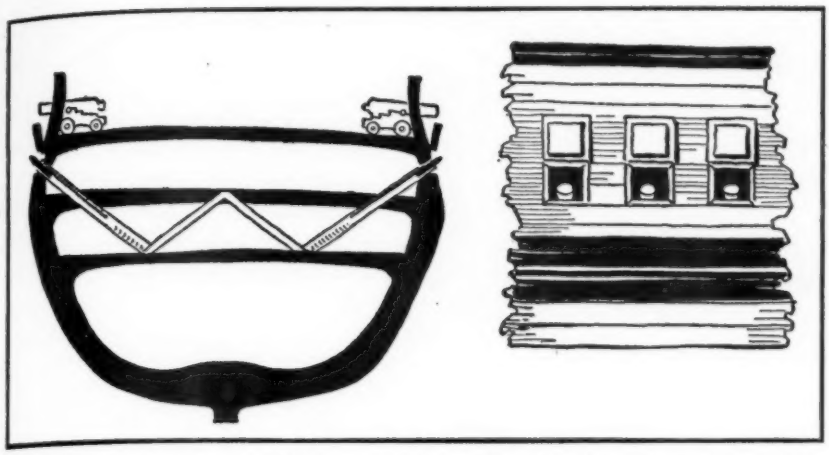
Rocket Corps Established

The British Rocket Corps was formally established on January 1, 1814, by command of the Prince Regent, later George IV. The now Col. Sir William Congreve declined its command, probably to avoid jealousy and to leave himself free to develop the weapon and to supervise its employment on land and sea.

So favorably impressed was all Europe by the rocket in the Napoleonic Wars that shortly thereafter rocket corps were established in Prussia, Poland, Russia, Holland, Switzerland, Greece, Sardinia, France, Spain, Italy, Austria, and Sicily. The fame of the Congreve rocket was not confined to the Continent. Early in 1813, trials of the weapon had been made in the United States, and, according to correspondence in the National Archives, some were made or procured and sent to the Canadian front although for some unknown reason they were not used in battle.

If the Americans did not choose to employ the new engine of war in the War of 1812, they had no choice about being the target, for the enemy fleet that raided the entire area of the Chesapeake Bay employed rockets in numerous small actions. Discharged from landing boats, they created much terror and did some execution, notably at the capture of Havre de Grace. The next summer they again appeared with the fleet's second and more extended visitation.

In June of 1814, Commodore Joshua Barney, commanding the flotilla defending the Chesapeake, reported to the Secretary of the Navy that the enemy had discharged rockets at his barges, burning one of them. He mentioned their inaccuracy but also that they outranged his heaviest guns. Shortly after this, Col. Decius Wadsworth reported successful rocket fire against his batteries supporting Barney



This cross section of a gun brig converted to a rocket ship shows the scuttles cut in the brig's side, below the gun deck, for rocket tubes that were independently aimed.

at the mouth of the Patuxent. Thus our first Chief of Ordnance was under rocket fire.

It was not until August 24th of this same year that the power of the weapon impressed itself upon the mind of the Nation. Though rockets did little execution at Bladensburg, they created such terror and confusion that they are credited with contributing largely to our complete defeat in that disastrous battle. Rocket infantry had already made their appearance on the Niagra frontier when, on July 25, 1814, they hurled their missiles at the troops of Winfield Scott in the battle of Lundy's Lane.

Bombardment of Fort McHenry

The heaviest and most specialized rocket fire of the war was reserved for Baltimore. Because the bombardment of Fort McHenry is of more than passing interest to all Americans and since the use of the rocket at that place is so well documented it will pay us to examine the action in some detail.

The entire attack upon Fort McHenry was confined to naval action. General Ross, whose army made the land attack on Baltimore, struck quite another sector of the city's defenses. Though Vice Admiral Cochrane's fleet of some fifty vessels included four line-of-battle ships and several frigates, their guns were not used against the fort. The six small vessels which conducted the bombardment employed the heaviest fortress-battering weapons afloat.

The AETNA, TERROR, METEOR, DEVASTATION, and VOLCANO, only ninety feet in length, were ketch-rigged bomb ships, each carrying two heavy sea mortars (some carried two 13-inch mortars, others one 10-inch and one 13-inch). The larger weapon hurled a 200-pound spherical shell for nearly 4,500 yards!

Operating with the bomb ships was the rocket ship EREBUS. She had been a 20-gun sloop of war and was converted to her present use under Congreve's personal supervision. She was the second ship to be turned to such use, and embodied several improvements.

EREBUS was fitted with twenty permanent dischargers on each broadside. These were iron tubes enclosed in wooden frames which led from the lower deck to ports cut in the ship's side just below the gun deck. Each of these breech-loading dischargers could fire a rocket every minute or so. They were, in effect, quick-firing guns, delivering a far greater volume of fire than could any other heavy weapon of that time. The original twenty light cannon were left for defensive use.

The missile hurled from the EREBUS' dischargers was that designated as the "32-pounder Bombardment Rocket, Sea Service." It could be equipped (at the arsenal) with various types of war heads—18- or 24-pound shot, 4½-inch shell, or incendiary carcass. A war head containing 18 pounds of incendiary mixture ranged 2,000 yards, and one of 12 pounds ranged 2,500 yards.

But because of the great range at which this bombardment was to be conducted, the smallest war head (with 8 pounds of mixture) and a range of 3,000 yards was exclusively used at Fort McHenry. The rocket was 4 inches in diameter, 31½ inches long, and its 1½-inch by 15-foot stick was—for sea service—in one piece.

In evaluating the two heavy weapons—mortar and rocket—employed in the 25-hour hammering of the fort, high score for actual destruction must be given to the mortar. Bomb ketches and the rocket ship were anchored 3,500 yards from their target, well within the mortars' range but at the outside extremity of the rockets' reach. Even the heaviest of the fort's guns—7-inch bore, 42-pounders—could not reach the vessels, yet the fort's commander states that some 400 bombshells fell within or behind the works. Most of the rockets, on the contrary, fell in the river, short of the fort.

After some eight hours of continuous firing the six ships shortened range, but when the fire of the shore batteries began to reach them, they withdrew to their original positions. In the advance, EREBUS approached considerably closer than did the bomb ships and held her advanced position longer. In fact Bartholomew, her captain, had to be peremptorily ordered for the second time to retreat. Which certainly shows that he had found the shortened range effective for his rockets.

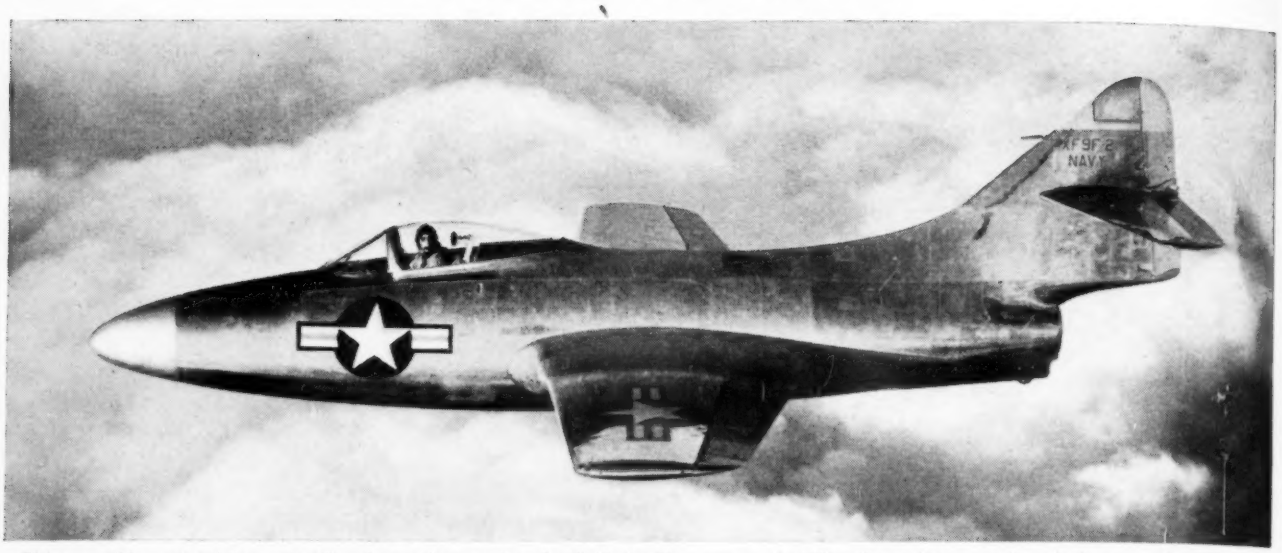
The Netherlands, in 1816, was first of the continental nations to attempt improvement of the rocket when a Dutch officer produced a stickless rocket stabilized by three vanes.

The rise of the war rocket in British service is undoubtedly due solely to the intelligence, character, and high position of its inventor. Without Sir William Congreve's unremitting and well-planned drive—taking all of his time and much of his money—the weapon would have been stymied time and again and pigeonholed as was the tank. Colonel Congreve printed (London, 1814) exclusively for the use of the officers of the new Rocket Corps and leaders of the services the beautifully illustrated "Details of the Rocket System." In it he gave not only the necessary detailed drill and performance of the rocket, but a well-planned tactic for the new arm.

"The Soul of Artillery"

He had at once grasped the fact that the greatest advantage of his weapon was its light weight and consequent great mobility. He summed it up in his favorite phrase—"the rocket is the soul of artillery without the body"—as true today as in 1814. He ranked the mass and rapidity of fire second only to its mobility as compared with the cannon of the period. (*To be concluded.*)

New Jet Aircraft



This new Navy jet fighter, the Panther, takes to the air. Built by Grumman, the 500-mile-an-hour carrier airplane can be powered by either the Rolls-Royce Nene turbo jet built by Pratt & Whitney or by the Allison 400 (J-35), both equally interchangeable.

America's first jet fighter with swept-back wings is this North American XP-86 in flight over the Mojave Desert. Although its exact performance and specifications are secret, the Air Force has revealed that its speed is in excess of 600 miles an hour.

The Navy's D-558-2 Skyrocket is a step nearer to penetrating the sonic speed barrier. Powered by jet and rocket engines, it has down- and back-swept wings. The pilot's air-conditioned cockpit is pressurized and can be jettisoned for high-speed escape.

Month by Month: A Review of the National Defense Situation

Survival in the Air Age.—The President's Air Policy Commission reported in January that our Military Establishment should be built around the air arm.

The report recognized the necessity of maintaining an adequate Navy and ground force. But it added that "it is the Air Force and naval aviation on which we must mainly rely. Our military security must be based on air power."

The Commission recommended that America start building up immediately to a first-line force of 12,400 new planes organized into 70 Regular Air Force, 27 National Guard, and 34 Air Reserve groups, plus 8,100 modern replacement craft.

"Biological weapons are undoubtedly being studied in all parts of the world," the Commission pointed out. "In an all-out attack on the United States the possibility that they may be used should not be overlooked. They may be delivered by the air or by preplacement by enemy agents."

The Commission believes that it is probable that other nations will develop atomic weapons before they develop in quantity supersonic bombers or supersonic guided missiles with a striking range of 5,000 miles.

Nevertheless, the Commission stated, it would be unwise to assume, in the planning of our defense establishment, that other nations will not have the planes and missiles capable of delivering a sustained attack on the United States mainland by the end of 1952.

The Commission viewed the record of the United Nations with little if any optimism, stating that the group could not assure a permanent peace except on a foundation of free communication throughout the world.

"Even the most optimistic view of the record of the United Nations," the report stated, "does not assure us that the United Nations will develop in time the necessary authority to prevent another great war."

In addition, the Commission recommended that:

1. Researchers press their quest for atom-powered airplanes.
2. Wartime secrecy be clamped down on advanced aëronautical development.
3. The aircraft-making industry be kept healthy by military purchases of 30 to 40 million pounds of airframes annually.
4. Stress be given to the consolidation and integration of the functions of our total Military Establishment and to the increase of the dollar efficiency of every segment of it.
5. The Navy immediately contract to increase its annual procurement of airplanes in order to equip properly the present fleet with modern planes as World War II reserves are exhausted.
6. The Air Transport Command and the Naval Air Transport Service be consolidated into one Military Air Transport Service.

Naval Strength.—Adm. Chester W. Nimitz, who retired in December as Chief of Naval Operations, asserted that our Navy holds such complete control of the seas that it can establish floating air bases off any shores from which to launch devastating attacks on inland targets.

He predicted that the Navy of the future will be capable of launching missiles from surface vessels and submarines and of delivering atomic bombs from carrier-based planes.

The United States now possesses control of the sea more absolute than was possessed by the British.

Admiral Nimitz translated this control into the terms of modern warfare by picturing the American fleet as capable of acting as a spearhead for aërial attacks until the more devastating flying fleets of the Air Force could begin operations from captured land bases.

In addition, he argued, the Navy would still have to protect the sea lanes for movement of critical supplies to the United States and the outward transport of invading forces and their supplies.

Forrestal Report.—Declaring that future policy of the defense establishment is predicated upon three basic needs, Secretary of Defense Forrestal released in January his latest "Activities Report" summarizing the functions of the nondepartmental agencies of the organization.

The Secretary outlined the three points of future planning as follows: (1) Assistance to industrial expansion; (2) Preparation of studies of the various categories of skills and management necessary to aid industrial expansion; and (3) An orderly program in the case of Air.

Preparing for hearings, the Committee on Civilian Components (Gray Board) is requesting data and comment from the governors of the various states and territories concerning the state missions of the National Guard and other civilian components.

A monitor for military mobilization needs has been set up with the Munitions Board. Known as the Requirements Division, it will check such needs at regular intervals and review all estimates, including those for military equipment, supplies, raw materials, and man power sent in by the Joint Chiefs of Staff, the Army, the Navy, and the Air Force, as well as by other divisions of the Munitions Board.

The Research and Development Board has been authorized to make decisions and resolve differences on research and development subjects among the several departments and agencies of the National Military Establishment.

The Committee on Basic Physical Sciences will evaluate the programs of the three services relating to basic physical science research and make recommendations for allocation and reallocation of projects among the services.

Specific subjects which the committee will consider are fluid dynamics, physics, chemistry, metallurgy and materials, and mathematics. It will foster development of improved metals capable of withstanding extremely high temperatures.

New District Chiefs.—To the roster of civilian chiefs of the Army Ordnance Districts have recently been added the names of three outstanding civilian leaders in as many important industrial areas of the country.

C. Jared Ingersoll has acceded to the many requests of the Chief of Ordnance and has resumed his former post as chief of the Philadelphia Ordnance District, an assignment he filled with distinction during a great part of World War II. A leader in industry and transporta-

tion, Mr. Ingersoll was instrumental in mobilizing the vast industrial resources of the Philadelphia area, the record of which was unsurpassed by any other section of the United States. For his outstanding contribution to Ordnance success in World War II he was awarded the Army's Medal of Merit. He is a director of the American Ordnance Association, a member of its executive committee, and a past president of the Philadelphia Post, A.O.A.

Charles J. Hardy, Jr., has accepted appointment as chief of the New York Ordnance District. He is president of American Car and Foundry Company and a director of that organization and of Carter Carburetor Corporation, Shipper's Car Line Corporation, ACF Export Company, ACF Investment Corporation, ACF Securities Corporation, Standard Forging Company (of Chicago), Pollard-Alling Manufacturing Company, and the Landrock Publishing Corporation. His company rendered outstanding service in the production of ordnance during World War II. He is the son of a distinguished father whose service to ordnance and to industry has been a guiding light through many years.

William J. Rushton, president of the Protective Life Insurance Company of Birmingham, has accepted appointment as chief of the Birmingham Ordnance District. During World War II he served as an Ordnance officer and contributed materially to the success of Ordnance activities in that area. He is a brother of Allen Rushton, Birmingham industrialist, who also rendered meritorious service to Ordnance and who recently retired as a member of Council of the American Ordnance Association, representing the Birmingham Post.

These three additions to the roster of Ordnance district chiefs emphasizes again the high caliber of the Industry-Ordnance organization and the patriotic coöperation of the gentlemen who are willing to give all their time and talents to this important work. As was announced in previous issues of this journal, civilian chiefs of other Ordnance districts at present are: John S. Pfeil, Boston; Don M. Compton, Chicago; William H. Mitchell, Cincinnati; Edward T. Gushee, Detroit; Lyman K. Stuart, Rochester; Adrian W. Frazier, St. Louis; and John S. Begley, Springfield.

Yearly Arms Plan.—To keep the United States to the forefront in the weapons race, the Research and Development Board has been ordered by Secretary of Defense Forrestal to submit at least once a year a new master plan for military research.

To gear the whole field of research with the strategic planning of the armed forces, the Joint Chiefs of Staff (the military heads of the armed forces, plus the Chief of Staff to the President) is instructed to provide general guidance for the board.

In doing this, according to the directive, the Joint Chiefs of Staff must "determine the relative importance of achieving military effectiveness of various possible weapon systems under envisaged combat conditions" and give their opinions to the Research Board.

The Munitions Board, which is coequal with the Joint Chiefs of Staff and the Research Board in the National Military Establishment, is instructed to keep the board posted on the types and availability of critical materials and substitutes needed in the scientific search for new weapons.

Soviet Guided Missiles.—For its own safety, particularly in view of the large number of German scientists known to be in Russia, the United States must assume that the Soviets can and will produce guided missiles comparable to any that can be produced in this country.

This opinion was expressed by John K. Northrop, one of the country's leading aëronautical engineers.

This assumption, Mr. Northrop said in an address at the University of Southern California, "leads to the very unpleasant conclusion that no portion of the United States could be considered safe from attack if Russia should choose to make one."

The whole country, he pointed out, is within 5,000 miles of the potential missile-launching area of Siberia, and our West Coast industry, a prime target, only 3,500 miles.

Further, he added, most American industrial centers are close to water, which the Bikini tests showed can increase many times the lethal effects of atomic bombs. The only American course "readily understandable by Russian psychology at the moment," Mr. Northrop suggested, "is a sufficiently strong and active Air Force to assure potential enemies of self-obliteration if they attack us."

He estimated that maintenance of aircraft production facilities at only five per cent of their wartime peak would provide an adequate nucleus for expansion in an emergency.

Occupation Policy Protest.—Herbert Hoover has spoken out against the current policy of dismantling German industrial plants.

In a foreword to a 21-page pamphlet recently issued by Common Cause, Inc., Mr. Hoover has this to say: "At a time when the world is crying, and even dying, from lack of industrial production, we apparently pursue the policy of destruction of the gigantic productive equipment in the western zones of Germany. It means less essential goods to all Europe, greater delay in recovery of the world, and larger drains on the American taxpayer."

Citing the announcement by United States and British occupation authorities on October 16, 1947, of a plan for dismantling 682 plants in the American and British zones, to which the French later added 236 plants in their zone, the pamphlet charges this is "uneconomic and unrealistic."

The group contends that only 338 of the 918 plants scheduled for dismantling are war plants and that these could be converted to peaceful products.

Canadian Ordnance Association.—By Letters Patent dated November 18, 1947, the Canadian Ordnance Association has been incorporated without share capital and without pecuniary benefit to its members.

Among the aims and objects of the association are to assist in effecting scientific and industrial preparedness for defense; to promote mutual understanding and effective coöperation between Canadian industry, technicians, and scientists with the active and reserve armed forces; to provide a medium for the pooling of the experience of industry, the armed forces, and veterans of previous wars for the proper and efficient equipment of the armed forces; and to provide, when required, the services of competent and experienced committees to investigate and report on special ordnance and mechanical subjects.

All Americans who realize the value of hemispheric defense will welcome the organization of this new society and extend it every wish for success in fostering industrial preparedness.

Essential Ingredient

FLEET ADMIRAL CHESTER W. NIMITZ in his farewell report as Chief of Naval Operations persuasively supports Sir Walter Raleigh's seventeenth-century dictum that "whosoever commands the sea commands the trade; whosoever commands the trade of the world commands the riches of the world and, consequently, the world itself."

¶ Admiral Nimitz points out that "Our present undisputed control of the sea was achieved primarily through the employment of naval air-sea power in the destruction of Japanese and German sea power," and he recommends that "A policy which provides for balanced development and coördinated use of strong naval forces should be vigorously prosecuted in order to meet and successfully counter a sudden war in the foreseeable future."

¶ The report of the President's Air Policy Commission, however, bluntly states that "We need a new strategic concept for the defense of the United States. This strategic concept must be based on air power."

¶ The report implies that the best defense is air offense—that the certain ability to mount an overwhelming retaliatory attack on any aggressor is the greatest possible deterrent against aggression.

¶ However, Gen. Jacob L. Devers, Commanding General, Army Ground Forces, recalls that "In World War II, establishment of beachheads and the invasion of Europe did not stop V-2 attacks. They did not stop until *ground forces* penetrated to the launching sites, destroyed the covering troops, and demolished the launching facilities."

¶ It seems profitless to argue over the relative essentiality of essentials, but it may not be amiss to suggest to the protagonists of air power, of sea power, and of old-fashioned but indispensable ground power that on land, in the air, on the water, or under the water the inescapable essential of essentials is firepower—in brief, *ordnance*.

¶ Until they are equipped with ordnance, the greatest number of the largest, fastest airplanes in the world are nothing but a flock of flying grandstands, impotent except as vantage points from which to give the enemy a good hard look. *Aircraft plus ordnance equals air power*.

¶ And in the perennial controversy over the relative merits of the airplane and the battleship, it might be worth while to remember that no airplane ever sank or even seriously damaged a battleship. Any naval vessels that were sunk, *were sunk by ordnance*.

¶ And yet in the 250 pages of testimony presented by the aircraft industry before the President's Air Policy Commission, a diligent search fails to locate a single mention of the indispensable element of air power—ordnance.

¶ By the same token, strip our navel vessels of ordnance and we no longer have a Navy. Strip our ground forces of ordnance and we may have well-fed, well-clothed, well-shod, well-paid, even well-trained and well-organized citizens—but we will not have an Army. The civilian does not become a soldier until we put in his hands the tools of the trade—ordnance.

¶ As a matter of fact, a realistic estimate of the international situation and a calm analysis of our Army, Navy, and Air Force needs will probably indicate that our whole concept of national defense is like a 3-legged stool—it needs all three legs in order to stand up. Remove or weaken any of the three and the whole thing collapses.

¶ At this particular juncture in our existence as a nation when our able Secretary of State, George C. Marshall, tells us dispassionately that "The way of life that we have known is literally in the balance," it might be well to remind ourselves that what we really need is a *balanced program*, and that in any prescription for national security *the essential ingredient is ordnance*.

James L Walsh

President, American Ordnance Association.

Association Affairs

INDUSTRY-ARMY DAYS: Conferences Held at Dallas and Omaha

National Industry-Army Days were held at Dallas, Tex., on January 23, 1948, and at Omaha, Nebr., on December 11, 1947, as part of a series of conferences between Army officials and industrialists being sponsored for the purpose of bringing leaders in management, business, and education together with top-ranking military officials for the discussion of industrial preparedness for the national defense.

It is hoped by such meetings to foster a close collaboration between America's industrial and military leaders which could well result in improved techniques of ordnance production and procurement. Such results may mean faster production and lower costs to the taxpayer both in peace and in war.

The Dallas Industry-Army Day conference was sponsored by the Lone Star Post of the American Ordnance Association in conjunction with other military associations which have representatives in the Texas area. Harry S. Zane, Jr., vice-president of the Lone Star Post, A.O.A., was chairman of the committee in charge of arranging the conference, and Maj. J. V. Galloway was assigned to duty in Dallas by Fourth Army headquarters to assist the committee.

Registration for the conference began at 9 A.M. in the Baker Hotel. From 11:30 A.M. to 1:30 P.M. a series of luncheons were held by a number of the associations for their own members and guests. The American Ordnance Association and the Air Force Association luncheons took place at the Baker Hotel, while the Chemical Corps Association, Army Signal Association, and Society of American Military Engineers held their luncheons at the Adolphus Hotel.

A closed conference for all those attending was held from 2 until 4:30 P.M. at the Baker Hotel where off-the-record addresses were given by Gen. J. Lawton Collins, Deputy Chief of Staff of the Army; Lieut. Gen. R. S. McLain of the Army public-relations staff; Maj. Gen. Emmett O'Donnell of the Air Force Department; and Thomas J. Hargrave, chairman of the United States Munitions Board.

These speakers told the assembled industrialists of the Army's dependence upon them for mass manufacture of necessary equipment in time of national emergency and outlined some of the problems inherent in such manufacture.

A social hour was held from 6 until 7 P.M. followed by a dinner in the Crystal Ballroom at which Gen. Omar Bradley, Chief of Staff Designate, was the principal speaker.

More than one thousand representatives from industry and the armed forces were present during the day's sessions.

The Industry-Army Day at Omaha on December 11th was likewise sponsored by the American Ordnance Association in conjunction with other military associations.

Charles D. Ammon, president of Cushman Motor Works and president of the Nebraska Post, A.O.A., was chairman of the committee in charge of arrangements. "Our lack of national industrial preparedness," said Mr. Ammon, "which occurred in both World Wars I and II should never be allowed to happen again. Through such meetings as this both industry and the armed forces can remain informed."

Maj. Gen. Everett S. Hughes, Chief of Army Ordnance, addressed the members of the Nebraska Post at a special industrial-preparedness luncheon held during the afternoon, and Gen. Mark W. Clark, hero and leader of the American campaign in Italy, now Commanding General of the Sixth Army, was the principal speaker at a dinner meeting in the evening.

Outstanding representatives from the Department of the Army and industry attended this meeting and gave a strong impetus to the cause of industrial preparedness in the Midwest.

ELECTIONS: Michigan Post Names New Officers and Directors

At the annual meeting of the board of directors of the Michigan Post, A.O.A., new officers were elected for the year. Robert L. Biggers was chosen president; Oscar Webber, first vice-president; Charles T. Fisher, Jr., second vice-president; and J. W. Paynter, secretary-treasurer.

In addition to these officers, the following directors will also serve as Post officials: Col. H. W. Alden, Robert P. Briggs, George T. Christopher, M. E. Coyle, Harvey C. Fruehauf, George R. Fink, Edward T. Gusheé, Phil Huber, K. T. Keller, George W. Kennedy, and S. T. Stackpole.

BIRMINGHAM POST: General Hughes Addresses Annual Meeting

Maj. Gen. Everett S. Hughes, Chief of Ordnance of the Army, was guest of honor and principal speaker at the annual dinner meeting and election of officers of the Birmingham Post of the Association held at the Mountain Brook Club in Birmingham, Ala., on January 9th. Col. Roy D. Hickman, retiring president of the Post, presided.

In the election of officers, Col. T. M. Nesbitt, Jr., was chosen president of the Post to succeed Colonel Hickman. Hugh P. Bigler was named vice-president and Robert Cotton, treasurer. Ralph E. Parker was reëlected Post secretary.

General Hughes, addressing the meeting, said that "The only way . . . to prevent a war is to be so ready that any prospective enemy will be aware of that fact." Calling upon the assembled industrialists to keep up with the trend of modern weapons he said: "The prospects for World War III are that we are going to be bombed. If our visualization of another war is correct we won't have any time to get ready. I am excluding any mention of guided missiles. It is a long time before we are going to have any guided missiles."

Following the dinner, General Hughes was guest of honor at a party at the Downtown Club in the Tutwiler Hotel and was presented with a gold key to the city by Colonel Hickman who represented the Birmingham Chamber of Commerce.

"RESURGENT INTEREST": Washington Post Maps Ambitious Program for 1948

A resurgent interest in our national defense is a sign of our times. In Washington, the Nation's Capital and focal point of its defense activities, a questionnaire about the future programming of meetings of the Post brought answers from over 400 members.

A survey of these replies clearly marks the road ahead in 1948. Monthly meetings are adequate. The membership is evenly divided in its choice of afternoon or evening get-togethers. Obviously, two meetings each month, alternately in the afternoon and evening, would allow more members to participate. Heading the list of preferred activities are visits to technical installations, followed in preference by movies and luncheons or dinners with prominent speakers.

In November, about 150 members and friends turned out for a return visit to the National Bureau of Standards. Several short talks and demonstrations and a tour of the laboratories proved interesting and informative.

On an evening in December about one hundred members and guests "groped" their way into the maze that is the Pentagon (now the "National Defense Building") for dinner in the General Officers' Dining Room and afterward witnessed a short program of Army and Air Force films.

Ahead in 1948 is an ambitious program: a visit to the Industrial College of the Armed Forces, a luncheon arranged by the U. S. Navy, and another luncheon or dinner with speakers from the office of the newly created Secretary of Defense. The goal is to renew, sustain, and increase the interest of the members in the vital need for military and industrial preparedness.

The board of directors of the Post met on January 20th at National Headquarters. F. W. Foster Gleason, who recently assumed the presidency of the Post (made vacant on the resignation of Col. D. St.P. Gaillard) was in the chair. Directors present were: H. T. Bodman, Bourbon Dawes, Harry Diamond, A. F. Ferrandou, T. G. Gentel, A. W. Mace, H. H. Mitchell, A. A. White, and R. P. Williams. F. E. Wright represented the Advisory Board.

Comdr. Carroll M. White, U.S.N., and Col. Philip Schwartz, U.S.A.F. Ordnance officer, were elected vice-presidents to serve until October 1, 1948.

The Post's activities for the current year were discussed and planned. In line with the greatly broadened horizon of the American Ordnance Association in the new setup of unified defense, all agreed to work for the extension of membership, to embrace the many organizations now brought within the ordnance field, and to assist in planning Post activities suitable to this extension. —F. W. F. GLEASON, *president;* H. J. CRAGER, *secretary.*

COMMUNISTIC INFILTRATION: Yankee Post Warned by Rev. Mr. Wilcox

An address by the Rev. Mr. Edward B. Wilcox, minister of the Unitarian Church of Lynn, Mass., on Communistic infiltration into industry was given at the dinner meeting of the Yankee Post, A.O.A., held at the Boston City Club, Boston, Mass., on December 3rd, and was enthusiastically received by those in attendance.

Rev. Mr. Wilcox described the Communistic organization existing in this country and particularly their methods of gaining control of labor unions, thus placing themselves in a position to control the workers in industry. He cited statements and regulations of the Communist party and many other facts to back up these assertions.

During World War II, Rev. Mr. Wilcox served for four years as a military intelligence officer of the Army.

A social hour, from 6 to 7 P.M., preceded the dinner meeting.—G. P. SLADE, *secretary-treasurer.*

HARTFORD-SPRINGFIELD: 300 Rally at First Postwar Meeting

More than 300 members of the Hartford-Springfield Post of the Association and their guests attended the first general meeting of the Post since the end of the war at the Hotel Bond in Hartford on Tuesday, December 9th. Representatives of industry from western Massachusetts and Connecticut heard Col. James L. Walsh, president of the A.O.A., and Brig. Gen. Donald Armstrong, executive vice-president of U. S. Pipe and Foundry Company and chairman of the A.O.A.'s Public Relations Committee, discuss the rôle of Ordnance in World War II and recommend steps which are vital to the establishment of an effective industrial mobilization program as part of the plan for national preparedness.

Stanley C. Hope, president of Gilbert & Barker Manufacturing Company, West Springfield, Mass., was elected president of the Hartford-Springfield Post at the business meeting. Col. Frederick H. Payne, retiring president, was elected chairman of the board of directors.

In accepting office, Mr. Hope lauded Colonel Payne's capable direction of the Post and cited his experience and efforts as a major reason for its present strong organization.

Colonel Walsh stressed the need for a sound and well-balanced program of national preparedness. He mentioned poison gas and biological warfare as weapons which were not used in World War II because the enemy knew we were prepared to retaliate in kind. Colonel Walsh questioned whether Japan would have dared to attack this country if we had been thoroughly prepared before Pearl Harbor.

In his talk, General Armstrong stated that the public must be informed of the need for effective industrial mobilization so that the plan will receive general support. He also advocated more standardization of industrial products to avoid duplication and wasted man-hours in the production of ordnance.—J. A. MACDONNELL, *secretary-treasurer.*

UNIVERSITY OF MICHIGAN: Reactivated Chapter Hears Noted Speakers

The Association has gained new strength in the recent reactivation of the University of Michigan Chapter by the R.O.T.C. Ordnance students on the campus. The following officers were elected at a meeting held for that purpose: President, L. E. Girton; vice-president, R. W. Parkinson, Jr.; treasurer, Henry J. Newnan, Jr.; secretary, A. W. Ott.

Col. J. M. Colby, chief of the Development Engineering Department, Detroit Tank Arsenal, gave an illustrated talk on "Modern Trends in Tank-Automotive Design" at the November 13th meeting. Recognized as a leading authority in the United States on this subject, Colonel Colby was recalled from his post as an observer with the British Army in North Africa upon America's entry into the war to take up his present duties.

On December 4th of last year, the chapter presented a panel discussion on the problem of mobilizing engineering talent for ordnance production. The highly qualified leaders of the discussion were Dean Ivan C. Crawford and Prof. John C. Brier of the University's Engineering School; Lieut. Col. John M. Cone, deputy chief of the Detroit Ordnance District; and Clinton H. Harris, chief engineer of Argus, Inc.

Dean Crawford, who served as a member of the Advisory Council, Military Service Division, Office, Chief of Ordnance, in the recent war, predicted the more efficient use of selective service in utilizing the specific capabilities of engineers, mechanics, and technicians in future wars.

Professor Brier, who was commanding officer of the Southwest Proving Ground, spoke of the use of engineering training in proving-ground operations.

In addition to the above meetings, the chapter was invited to attend a meeting of the Michigan Post through the good offices of R. L. Biggers, Post president.

NECROLOGY

Notice has been received of the deaths of the following members of the Association: W. F. Arndt, Duluth, Minn.; Henry Arts, Ladysmith, Wis.; R. S. Blodgett, Waltham, Mass.; W. Gibson Carey, Jr., New York, N. Y.; D. B. Clark, Webster, Mass.; W. H. Crim, Salem, Ind.; J. S. Darcy, Thomaston, Conn.; A. L. Egge, Hibbing, Minn.; A. M. Elton, Newport, Ark.; H. B. Hackett, Philadelphia, Pa.; W. G. Heil, West Haven, Conn.; B. M. Kent, Cleveland, Ohio; R. M. Longenecker, Arcanum, Ohio; R. B. Pottinger, Racine, Wis.; J. L. Purcell, Denver, Colo.; D. D. Shell, Erwin, Tenn.; C. F. Sioberg, York, Pa.; C. W. Smith, Cuyahoga Falls, Ohio; Howard Sumner, Princeton, Ind.; R. J. Thanisch, Boston, Mass.; G. R. Whippo, Cleveland, Ohio. To their relatives and friends, ORDNANCE, on behalf of the Association membership, extends condolences.

The National Divisions, A.O.A.

THE DIVISIONS AND COMMITTEES

At the present time there are five regularly functioning Technical Divisions of the American Ordnance Association: Artillery; Fire Control Instrument; Gage Industry; Rocket, Bomb, and Artillery Ammunition; Small Arms and Small Arms Ammunition. These Divisions are organized along commodity rather than functional lines in order to handle best the problems received from the armed services.

In addition, there are currently active four special committees: Industrial Mobilization; Machine Tool; Coöperation with Other Organizations; Research and Development. Additional A.O.A. Divisions and special committees are presently contemplated which will be organized when there is definite need for them to assist the armed services. It is not the policy of the American Ordnance Association to activate or to continue the existence of Divisions or committees for which there are no present nor anticipated requirements.

These Divisions and special committees are authorized by the constitution and by-laws of the American Ordnance Association which states that "these Divisions . . . shall be devoted to the advancement of knowledge, engineering practices, and production techniques relating to particular fields of ordnance."

The Divisions and special committees function under the supervision of Harvey C. Knowles, vice-president of the American Ordnance Association, in accordance with policies and objectives established by the Executive Committee of the Association.

It is not the policy of the American Ordnance Association to duplicate the work of other associations or societies, but to work side by side with them to assist the national-defense agencies of our Government which are responsible for the design, production, and maintenance of ordnance.

It is A.O.A. policy, through membership in the Divisions, to keep together and perpetuate skilled experienced groups in critical ordnance fields for which there is little or no peacetime industry and to keep these groups alert, interested in, and familiar with national-defense problems, procedures, and agencies.

It is the policy of the American Ordnance Association that committee chairmen take the lead at all meetings, calling on their contact officials in the armed services for necessary data on specific problems and for the presence of officers and civilian employees at meetings as may be required. Committee procedures are simple and free from red tape. Direct liaison between committee chairmen and their contact officials is normal practice.

The problem received by a committee may be so involved that the committee will recommend several possible methods or sources which the particular department of the armed services may contact for a possible solution. The particular committee may later be asked to get a disinterested evaluation of the solution obtained.

In many instances, the problems received from the armed services by the Association's Divisions and committees involve planning policies and procedures of a restricted nature so that no publicity can be given the reports of the committees. Problems of such important character, however, further strengthen the bond of confidence between industry and the armed forces of the country.

The leaders of American industry making up these Divisions and committees also know full well the value of the "time factor" in modern warfare and realize in their committee work that they are actually implementing the time-honored slogan of the American Ordnance Association—"Industrial preparedness is the Nation's strongest guaranty of peace."

ARTILLERY DIVISION

The executive committee of the Artillery Division held a meeting at Watertown Arsenal, Mass., on January 30, 1948, at the request of Col. W. R. Gerhardt, the commanding officer, to advise with him on various industrial war-planning problems pertaining to the activities of his arsenal.

In view of the general similarity of certain of these problems with those of the other two artillery arsenals of the Ordnance Department, representatives of the Rock Island and Watervliet Arsenals were present at this meeting.

The committee was also afforded the opportunity of familiarizing themselves with the equipment and capabilities of this large arsenal by means of a carefully planned tour of inspection through the various offices, shops, and laboratories.

Col. Walter W. Warner, commanding officer of Rock Island, has invited the Artillery Division executive committee to meet with him at the arsenal in the near future to discuss similar problems relating to this facility.

ROCKET, BOMB, AND ARTILLERY AMMUNITION DIVISION

This A.O.A. Division has recently submitted to the Chief of Ordnance of the Army a series of carefully prepared reports on twenty major policy questions covering operational procedures to be followed by the Ordnance Department in industrial war planning on ammunition.

The logistical aspects of these problems studied and reported upon by the various committees of this Division were of the greatest importance to the Ordnance Department. In expressing his appreciation for these reports to Mr. Knowles, the chairman of this Division, Maj. Gen. Everett S. Hughes, Chief of Ordnance, remarked that the problems had been so thoroughly analyzed that many parts of the reports could be utilized without change in the official industrial mobilization plans of the Ordnance Department.

GAGE INDUSTRY DIVISION

This American Ordnance Association Division has recently been advised by the chief of the St. Louis Ordnance District that a new Ordnance gage laboratory will shortly be established at the Midwest Research Institute, Kansas City, Mo. The plans, specifications, and technical problems involved are now being studied by the St. Louis Ordnance District office and by the central gage laboratory of the Ordnance Department located at Frankford Arsenal, Pa.

As soon as these preliminary studies have been completed, the specific problems involved will be presented by Brig. Gen. E. E. MacMorland of Frankford Arsenal to Louis Polk, president of the Sheffield Corporation, Dayton, Ohio, who is chairman of the Association's Gage Industry Division. Arrangements are now being made for a meeting of the executive committee of the Gage Industry Division with interested representatives of the Ordnance Department of the Army.

PROBLEMS WANTED

All members of the Industry-Ordnance team are invited to make every possible use of the A.O.A. Divisions. Any problems concerned with design, production, and maintenance of ordnance matériel may be referred to the Association for assignment to the proper Division for solution.

Likewise, manufacturers who have solved some intricate problem of ordnance production may communicate their findings to the A.O.A. for the benefit of other manufacturers who may be asked to produce similar items.

Through such coöperation and interest in the common cause of industrial preparedness mutual Industry-Ordnance difficulties will be ironed out quickly and efficiently.

Honor Roll of Industrial Preparedness

Here are inscribed the names of the Company Members of the American Ordnance Association, some of the principal industrial organizations of the United States which are leaders in effecting scientific and industrial preparedness for our security and peace.

ACF-BRILL MOTORS COMPANY . . . PHILADELPHIA
ACME STEEL COMPANY . . . . . CHICAGO
ADVANCE STAMPING COMPANY . . . . . DETROIT
AEROJET ENGINEERING CORPORATION . . . AZUSA
AETNA-STANDARD ENGINEERING COMPANY . . . . . YOUNGSTOWN
AIR REDUCTION SALES COMPANY . . . NEW YORK
AJAX ELECTROTHERMIC CORPORATION . TRENTON
ALLEGHENY LUDLUM STEEL CORP. . . BRACKENRIDGE
ALLIS-CHALMERS MANUFACTURING COMPANY . . . . . MILWAUKEE
ALTON BOX BOARD COMPANY . . . . . ALTON
ALTORFER BROTHERS COMPANY . . . . PEORIA
ALUMINUM COMPANY OF AMERICA . . . PITTSBURGH
AMERICAN BANTAM CAR COMPANY . . . . BUTLER
AMERICAN BOSCH CORPORATION . . SPRINGFIELD
AMERICAN BRASS COMPANY . . . . WATERBURY
AMERICAN CAR AND FOUNDRY COMPANY . NEW YORK
AMERICAN FORK & HOE COMPANY . . . CLEVELAND
AMERICAN HYDRAULICS, INC. . . . . SHEBOYGAN
AMERICAN INSTRUMENT COMPANY . . SILVER SPRING
AMERICAN LOCOMOTIVE COMPANY . . . NEW YORK
AMERICAN MACHINE & FOUNDRY CO. . . NEW YORK
AMERICAN METAL PRODUCTS COMPANY . . DETROIT
AMERICAN PULLEY COMPANY . . . PHILADELPHIA
AMERICAN RADIATOR & STANDARD SANITARY CORPORATION . . . . . PITTSBURGH
AMERICAN SEATING COMPANY . . . GRAND RAPIDS
AMERICAN STEEL & WIRE COMPANY . . CLEVELAND
AMERICAN VISCOSE CORPORATION . . . WILMINGTON
AMP CORPORATION . . . . . ST. LOUIS
ANCHOR PACKING COMPANY . . . PHILADELPHIA
ANHEUSER-BUSCH, INC. . . . . ST. LOUIS
ANIMAL TRAP COMPANY OF AMERICA . . . LITITZ
ARMSTRONG CORK COMPANY . . . . LANCASTER
ASSOCIATED SPRING CORPORATION . . . BRISTOL
ATLANTIC SHEET METAL CORPORATION . . ATLANTA
ATLAS POWDER COMPANY . . . . WILMINGTON
AUSTIN POWDER COMPANY . . . . . CLEVELAND
AUTOCAR COMPANY . . . . . ARDMORE
AUTO SPECIALTIES MANUFACTURING COMPANY . . . . . ST. JOSEPH

B. G. MACHINE COMPANY . . . . . NEW HAVEN
BAGLEY & SEWALL COMPANY . . . . WATERTOWN
BAKER & COMPANY . . . . . NEWARK
BAKER OIL TOOLS, INC. . . . . LOS ANGELES
BALDWIN COMPANY . . . . . CINCINNATI
BARNES COMPANY, W. F. & JOHN . . . ROCKFORD
BASTIAN-BLESSING COMPANY . . . . . CHICAGO
BAUER BROTHERS COMPANY . . . SPRINGFIELD
BELL & HOWELL COMPANY . . . . . CHICAGO
BELL TELEPHONE COMPANY OF PENNSYLVANIA . . . . . PHILADELPHIA
BELLE CITY MALLEABLE IRON COMPANY . . RACINE
BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE COMPANY . . . . . ELYRIA
BETHLEHEM STEEL CORPORATION . . . BETHLEHEM
BIRDSBORO STEEL FOUNDRY & MACHINE COMPANY . . . . . BIRDSBORO
BLACK & DECKER MANUFACTURING COMPANY TOWSON
BLANCHARD MACHINE COMPANY . . . CAMBRIDGE
BLAW-KNOX COMPANY . . . . . BLAWNOX
BOSSERT COMPANY . . . . . UTICA
BOUND BROOK OIL-LESS BEARING COMPANY . . . . . BOUND BROOK
BOWSER, INC. . . . . FORT WAYNE
BREEZE CORPORATIONS, INC. . . . . NEWARK
BRIDGEPORT BRASS COMPANY . . . BRIDGEPORT
BRIGGS & STRATTON CORPORATION . . MILWAUKEE
BUCKEYE STEEL CASTINGS COMPANY . . COLUMBUS
BUCYRUS-ERIE COMPANY . . SOUTH MILWAUKEE
BUHL MANUFACTURING COMPANY . . . . DETROIT
BULOVA WATCH COMPANY . . . . . NEW YORK
BURKE COMPANY, O. W. . . . . DETROIT
BURKEY UNDERWEAR COMPANY . . . HAMBURG
BUTTERWORTH & SONS CO., H.W. . . PHILADELPHIA

CAREY-MCFALL COMPANY . . . . PHILADELPHIA
CARGOCAIRE ENGINEERING CORPORATION . NEW YORK
CARNEGIE-ILLINOIS STEEL CORPORATION PITTSBURGH
CARTER CARBURETOR CORPORATION . . ST. LOUIS
CASE COMPANY, J. I. . . . . RACINE
CATERPILLAR TRACTOR COMPANY . . . . PEORIA
CELANESE CORPORATION OF AMERICA . . NEW YORK
CENTRAL FOUNDRY COMPANY . . . . NEW YORK
CHAIN BELT COMPANY . . . . . MILWAUKEE
CHAMBERLIN COMPANY OF AMERICA . . . DETROIT
CHASE BRASS & COPPER COMPANY . . WATERBURY
CHICAGO EXTRUDED METALS COMPANY . . CICERO
CHRISTEN & SONS COMPANY, FRED . . . TOLEDO
CHRYSLER CORPORATION . . . . . DETROIT
CINCINNATI MILLING MACHINE COMPANY CINCINNATI
CITIES SERVICE DEFENSE CORPORATION . SHREVEPORT
CLARK GRAVE VAULT COMPANY . . . COLUMBUS
CLARY MULTIPLIER CORPORATION . . LOS ANGELES
CLEARING MACHINE CORPORATION . . . . CHICAGO
CLEVELAND CONTAINER COMPANY . . . CLEVELAND
CLEVELAND GRAPHITE BRONZE COMPANY . CLEVELAND

(*Continued on next page*)

HONOR ROLL OF INDUSTRIAL PREPAREDNESS

Here are inscribed the names of the Company Members of the American Ordnance Association, some of the principal industrial organizations of the United States which are leaders in effecting scientific and industrial preparedness for our security and peace.

COBUSCO STEEL PRODUCTS . . . . . DENVER
COCA-COLA COMPANY . . . . . ATLANTA
COLORADO FUEL & IRON CORPORATION . . DENVER
COLT'S MANUFACTURING COMPANY. . . HARTFORD
COLUMBUS BOLT WORKS COMPANY . . COLUMBUS
COMBUSTION ENGINEERING COMPANY . . NEW YORK
CONTAINER CORPORATION OF AMERICA . . CHICAGO
COPPERWELD STEEL COMPANY . . . . . WARREN
CORBITT COMPANY . . . . . HENDERSON
CRANE COMPANY . . . . . CHICAGO
CROWN CORK & SEAL COMPANY . . . BALTIMORE
CUSHMAN MOTOR WORKS . . . . . LINCOLN
CUTLER-HAMMER, INC. . . . . MILWAUKEE

DALTON FOUNDRIES, INC. . . . . WARSAW
DARLING VALVE & MANUFACTURING COMPANY . . . . . WILLIAMSPORT
DAVIS COMPANY, H. B. . . . . BALTIMORE
DAVISON CHEMICAL CORPORATION . . . BALTIMORE
DAYTON RUBBER MANUFACTURING COMPANY . DAYTON
DEERE & COMPANY . . . . . MOLINE
DEFIANCE AUTOMATIC SCREW COMPANY . DEFIANCE
DELCO-REMY DIVISION, GMC . . . . ANDERSON
DELTA MANUFACTURING COMPANY . . MILWAUKEE
DETROIT AUTOMOTIVE PRODUCTS CORP. . . DETROIT
DEXTER COMPANY . . . . . FAIRFIELD
DISSTON & SONS, INC., HENRY . . . PHILADELPHIA
DOEHLER-JARVIS CORPORATION . . . NEW YORK
DRAVO CORPORATION . . . . . PITTSBURGH
DUNCAN ELECTRIC MANUFACTURING COMPANY . . . . . LAFAYETTE
DU PONT DE NEMOURS & COMPANY, E. I. WILMINGTON
DURASTEEL COMPANY . . . . . HANNIBAL
DURIRON COMPANY . . . . . DAYTON
DUTTON COMPANY, C. H. . . . . KALAMAZOO

EASTERN STAINLESS STEEL CORPORATION . BALTIMORE
EASTERN TOOL & MANUFACTURING COMPANY . . . . . BLOOMFIELD
EASTMAN KODAK COMPANY . . . . ROCHESTER
EASY WASHING MACHINE CORPORATION . SYRACUSE
EATON MANUFACTURING COMPANY . . CLEVELAND
EDGEWATER STEEL COMPANY . . . PITTSBURGH
EDISON, INC., THOMAS A. . . . . WEST ORANGE
ELECTRIC AUTO-LITE COMPANY . . . . TOLEDO
ELECTRIC FURNACE COMPANY . . . . . SALEM
ELECTRIC STORAGE BATTERY COMPANY PHILADELPHIA
ELGIN NATIONAL WATCH COMPANY . . . ELGIN
EMERSON ELECTRIC MANUFACTURING COMPANY . . . . . ST. LOUIS
EVANS' SONS, INC., JOHN . . . . PHILADELPHIA
EXACT WEIGHT SCALE COMPANY . . . COLUMBUS
EX-CELL-O CORPORATION . . . . . DETROIT

FAIRBANKS, MORSE & COMPANY . . . . BELOIT
FALK CORPORATION . . . . . MILWAUKEE
FARBER, INC., S. W. . . . . BROOKLYN
FARQUHAR COMPANY, A. B. . . . . YORK
FEDERAL LABORATORIES, INC. . . . . PITTSBURGH
FEDERAL MOTOR TRUCK COMPANY . . . . DETROIT
FERRO MACHINE & FOUNDRY COMPANY . CLEVELAND
FLANNERY BOLT COMPANY . . . . . BRIDGEVILLE
FOLLANSBEE STEEL CORPORATION . . . PITTSBURGH
FOUR WHEEL DRIVE AUTO COMPANY . CLINTONVILLE
FRAM CORPORATION . . . . . PROVIDENCE
FRENCH & SONS PIANO DIVISION, H. & A. SELMER, INC. . . . . NEW CASTLE
FRICK-GALLAGHER MANUFACTURING COMPANY . . . . . WELLSTON
FULLER BRUSH COMPANY . . . . . HARTFORD
FURNAS ELECTRIC COMPANY . . . . . BATAVIA

GAIR COMPANY, ROBERT . . . . . NEW YORK
GATES RUBBER COMPANY . . . . . DENVER
GENERAL DYESTUFF CORPORATION . . NEW YORK
GENERAL ELECTRIC COMPANY . . . SCHENECTADY
GENERAL FIREPROOFING COMPANY . YOUNGSTOWN
GENERAL STEEL CASTINGS CORPORATION EDDYSTONE
GENERAL TEXTILE MILLS, INC. . . . . NEW YORK
GENERAL TIME INSTRUMENTS CORP. . . NEW YORK
GENERAL TIRE & RUBBER COMPANY . . . AKRON
GERITY-MICHIGAN CORPORATION . . . . ADRIAN
GERSTENSLAGER COMPANY . . . . . WOOSTER
GIDDINGS & LEWIS MACHINE TOOL COMPANY . . . . . FOND DU LAC
GILBERT & BARKER MANUFACTURING COMPANY . . . . . SPRINGFIELD
GILLETTE SAFETY RAZOR COMPANY . . . BOSTON
GLIDDEN COMPANY . . . . . CLEVELAND
GLOBE MACHINE & STAMPING COMPANY . CLEVELAND
GLOBE-UNION, INC. . . . . MILWAUKEE
GOODRICH COMPANY, B. F. . . . . AKRON
GRANITE CITY STEEL COMPANY . . GRANITE CITY
GREAT LAKES STEEL CORPORATION . . . ECORSE
GREDE FOUNDRIES, INC. . . . . MILWAUKEE
GREENFIELD TAP & DIE CORPORATION . GREENFIELD
GULF OIL CORPORATION . . . . . PITTSBURGH

HANNIFIN CORPORATION . . . . . CHICAGO
HARNISCHFEGER CORPORATION . . . MILWAUKEE
HARRINGTON & RICHARDSON ARMS COMPANY . . . . . WORCESTER
HARRINGTON-WILSON-BROWN COMPANY . NEW YORK
HARRISBURG STEEL CORPORATION . . . HARRISBURG
HARRIS-SEYBOLD COMPANY . . . . CLEVELAND
HARSHAW CHEMICAL COMPANY . . . CLEVELAND
HARVEY MACHINE COMPANY . . . LOS ANGELES
HEIL COMPANY . . . . . MILWAUKEE
HEINEMANN ELECTRIC COMPANY . . . TRENTON
HEINTZ MANUFACTURING COMPANY . PHILADELPHIA
HENDEY MACHINE COMPANY . . . TORRINGTON
HENDRICK MANUFACTURING COMPANY . CARBONDALE
HENRY & WRIGHT MANUFACTURING COMPANY . . . . . HARTFORD
HEPPENSTALL COMPANY . . . . . PITTSBURGH
HERCULES MOTORS CORPORATION . . . . CANTON

Here are inscribed the names of the Company Members of the American Ordnance Association, some of the principal industrial organizations of the United States which are leaders in effecting scientific and industrial preparedness for our security and peace.

HONOR ROLL OF INDUSTRIAL PREPAREDNESS

HERCULES POWDER COMPANY . . . . WILMINGTON
HEYDEN CHEMICAL CORPORATION . . . NEW YORK
HIGH SPEED HAMMER COMPANY . . . ROCHESTER
HOBART MANUFACTURING COMPANY . . . TROY
HOE & COMPANY, R. . . . . NEW YORK
HOLLINGSHEAD CORPORATION, R. M. . . . CAMDEN
HOOVER COMPANY . . . . . NORTH CANTON
HOUGHTON & COMPANY, E. F. . . . PHILADELPHIA
HUGHES TOOL COMPANY . . . . . HOUSTON
HYATT BEARINGS DIVISION, GMC . . . HARRISON

INLAND STEEL COMPANY . . . . . CHICAGO
INTERCHEMICAL CORPORATION . . . NEW YORK
INTER-COASTAL PAINT CORPORATION . . BALTIMORE
INTERNATIONAL BUSINESS MACHINES CORPORATION . . . . . NEW YORK
INTERNATIONAL CHAIN & MANUFACTURING COMPANY . . . . . YORK
INTERNATIONAL HARVESTER COMPANY . . CHICAGO
INTERNATIONAL NICKEL COMPANY . . NEW YORK

JACOBS COMPANY, F. L. . . . . DETROIT
JOA, INC., CURT G. . . . . SHEBOYGAN
JOHNS-MANVILLE SALES CORPORATION . NEW YORK
JOHNSON AUTOMATICS, INC. . . . . BOSTON
JONES & LAMSON MACHINE COMPANY . SPRINGFIELD
JONES & LAUGHLIN STEEL CORPORATION . PITTSBURGH

KEARNEY & TRECKER CORPORATION . . WEST ALLIS
KELLY-SPRINGFIELD TIRE COMPANY . CUMBERLAND
KELSEY-HAYES WHEEL COMPANY . . . . DETROIT
KENWORTH MOTOR TRUCK CORPORATION . . SEATTLE
KEUFFEL & ESSER COMPANY . . . . HOBOKEN
KING-SEELEY CORPORATION . . . . ANN ARBOR
KINGSBURY MACHINE TOOL CORPORATION . KEENE
KNAPP-MONARCH COMPANY . . . . ST. LOUIS
KOEHRING COMPANY . . . . . MILWAUKEE
KOHLER COMPANY . . . . . KOHLER
KOPPERS COMPANY . . . . . PITTSBURGH

LAKE CITY MALLEABLE IRON COMPANY . CLEVELAND
LANDIS TOOL COMPANY . . . . . WAYNESBORO
LANSDOWNE STEEL & IRON COMPANY . . . MORTON
LAPOINTE MACHINE TOOL COMPANY . . . HUDSON
LEBANON STEEL FOUNDRY . . . . . LEBANON
LEE TIRE & RUBBER COMPANY . . . CONSHOHOCKEN
LEEDS & NORTHRUP COMPANY . . . PHILADELPHIA
LEHIGH FOUNDRIES, INC. . . . . EASTON
LIEBERKNECHT, INC., KARL . . . . READING
LINCOLN ELECTRIC COMPANY . . . . CLEVELAND
LINCOLN ENGINEERING COMPANY . . . ST. LOUIS
LINK-BELT COMPANY . . . . . CHICAGO
LUKENS STEEL COMPANY . . . . COATESVILLE
LYNCHBURG FOUNDRY COMPANY . . LYNCHBURG

MARLIN-ROCKWELL CORPORATION . . JAMESTOWN
MASLAND & SONS, C. H. . . . . CARLISLE
MASON & HANGER COMPANY . . . . NEW YORK
MATHEWS CONVEYER COMPANY . . ELLWOOD CITY
MAXSON CORPORATION, W. L. . . . . NEW YORK
MCKAY COMPANY . . . . . PITTSBURGH
MERCK & COMPANY . . . . . RAHWAY
MICA INSULATOR COMPANY . . . . NEW YORK
MIDWEST PIPING AND SUPPLY COMPANY . ST. LOUIS
MILCO UNDERGARMENT COMPANY . . BLOOMSBURG
MILSCO MANUFACTURING COMPANY . . MILWAUKEE
MINES EQUIPMENT COMPANY . . . . ST. LOUIS
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY . . . . . MINNEAPOLIS
MINNEAPOLIS-MOLINE POWER IMPLEMENT COMPANY . . . . . MINNEAPOLIS
MISSISSIPPI RIVER FUEL CORPORATION . ST. LOUIS
MONROE AUTO EQUIPMENT COMPANY . . . MONROE
MONROE CALCULATING MACHINE COMPANY . ORANGE
MOORE ENAMELING & MANUFACTURING COMPANY . . . . . WEST LAFAYETTE
MOSLER SAFE COMPANY . . . . . HAMILTON
MULLINS MANUFACTURING CORPORATION . . SALEM
MUNSINGWEAR, INC. . . . . MINNEAPOLIS

NARROW FABRIC COMPANY . . . . . READING
NASH ENGINEERING COMPANY . . SOUTH NORWALK
NATIONAL ACME COMPANY . . . . . CLEVELAND
NATIONAL ASSOCIATION OF INSURANCE AGENTS . . . . . NEW YORK
NATIONAL ENAMELING & STAMPING COMPANY . . . . . MILWAUKEE
NATIONAL LOCK WASHER COMPANY . . . NEWARK
NATIONAL MALLEABLE & STEEL CASTINGS COMPANY . . . . . CLEVELAND
NATIONAL SCREW & MANUFACTURING COMPANY . . . . . CLEVELAND
NATIONAL SLUG REJECTORS, INC. . . . ST. LOUIS
NATIONAL SUPPLY COMPANY . . . . PITTSBURGH
NEW BRITAIN MACHINE COMPANY . . NEW BRITAIN
NEW ENGLAND BOX COMPANY . . . . GREENFIELD
NEW YORK AIR BRAKE COMPANY . . . NEW YORK
NORDBERG MANUFACTURING COMPANY . MILWAUKEE
NORRIS STAMPING & MANUFACTURING COMPANY . . . . . LOS ANGELES
NORTON COMPANY . . . . . WORCESTER

OAKITE PRODUCTS, INC. . . . . NEW YORK
OCEAN CITY MANUFACTURING COMPANY PHILADELPHIA
OHIO FALLS DYE & FINISHING WORKS . . LOUISVILLE
OILGEAR COMPANY . . . . . MILWAUKEE
OLIN INDUSTRIES, INC. . . . . EAST ALTON
OLIVER CORPORATION . . . . . CLEVELAND
OMAHA STEEL WORKS . . . . . OMAHA
OTIS ELEVATOR COMPANY . . . . . NEW YORK

PARISH PRESSED STEEL COMPANY . . . . READING
PARKER RUST-PROOF COMPANY . . . . DETROIT
PEMCO CORPORATION . . . . . BALTIMORE
PERFEX CORPORATION . . . . . MILWAUKEE
PFIZER & COMPANY, CHARLES . . . . NEW YORK

(Continued on next page)

HONOR ROLL OF INDUSTRIAL PREPAREDNESS

Here are inscribed the names of the Company Members of the American Ordnance Association, some of the principal industrial organizations of the United States which are leaders in effecting scientific and industrial preparedness for our security and peace.

PHEOLL MANUFACTURING COMPANY . . . CHICAGO
PLUMB, INC., FAYETTE R. . . . . PHILADELPHIA
PRESSED STEEL CAR COMPANY . . . . . CHICAGO

RATHBORNE HAIR & RIDGWAY COMPANY . . CHICAGO
RCA VICTOR DIVISION, RADIO CORP. OF AMERICA . . . . . CAMDEN
REMINGTON RAND, INC. . . . . STAMFORD
REPUBLIC STEEL CORPORATION . . . CLEVELAND
REVERE COPPER & BRASS, INC. . . . NEW YORK
REYNOLDS METALS COMPANY . . . . RICHMOND
REYNOLDS SPRING COMPANY . . . . JACKSON
RHEEM MANUFACTURING COMPANY . . NEW YORK
ROBERTSHAW THERMOSTAT COMPANY . YOUNGWOOD
ROSS GEAR AND TOOL COMPANY . . . LAFAYETTE
RUDEL MACHINERY COMPANY . . . . NEW YORK
RUSSELL MANUFACTURING COMPANY . . MIDDLETON
RUSTLESS IRON & STEEL DIVISION, AMERICAN ROLLING MILL COMPANY . . . . . BALTIMORE

SAGINAW MALLEABLE IRON DIVISION, GMC SAGINAW
ST. LOUIS CAR COMPANY . . . . . ST. LOUIS
SALEM ENGINEERING COMPANY . . . . SALEM
SAVAGE ARMS CORPORATION . . . . . UTICA
SCHLITZ BREWING COMPANY, JOSEPH . . MILWAUKEE
SCHLUETER MANUFACTURING COMPANY . ST. LOUIS
SCHWITZER-CUMMINS COMPANY . . INDIANAPOLIS
SCOVILL MANUFACTURING COMPANY . . WATERBURY
SCULLIN STEEL COMPANY . . . . . ST. LOUIS
SERVEL, INC. . . . . EVANSVILLE
SIMONDS SAW & STEEL COMPANY . . . FITCHBURG
SIMMONS COMPANY . . . . . NEW YORK
SINGER MANUFACTURING COMPANY . ELIZABETHPORT
SKF INDUSTRIES, INC. . . . . PHILADELPHIA
SMITH CORPORATION, A. O. . . . . MILWAUKEE
SMITH & CORONA TYPEWRITERS, INC., L. C. SYRACUSE
SMITH & WESSON, INC. . . . . SPRINGFIELD
SOSS MANUFACTURING COMPANY . . . . DETROIT
SOUTH CHESTER TUBE COMPANY . . . . CHESTER
SOUTHERN CALIFORNIA PLANT, GMC . SOUTH GATE
SPERRY GYROSCOPE COMPANY . . . . GREAT NECK
SPICER MANUFACTURING DIVISION, DANA CORPORATION . . . . . TOLEDO
SQUARE D COMPANY . . . . . DETROIT
STANDARD PRESSED STEEL COMPANY . JENKINTOWN
STANDARD STEEL SPRING COMPANY . . CORAOPOLIS
STANDARD TUBE COMPANY . . . . . DETROIT
STEARNS-ROGER MANUFACTURING COMPANY DENVER
STERLING MOTOR TRUCK COMPANY . . MILWAUKEE
STONE & WEBSTER ENGINEERING CORPORATION . . . . . NEW YORK
STRATFORD ENGINEERING CORPORATION . KANSAS CITY
STRELINGER COMPANY, CHAS. A. . . . . DETROIT
STUART OIL COMPANY, D. A. . . . . CHICAGO
SUN OIL COMPANY . . . . . PHILADELPHIA
SURFACE COMBUSTION CORPORATION . . . TOLEDO
SUSQUEHANNA MILLS, INC. . . . . NEW YORK
SWANK, INC. . . . . ATTLEBORO
SYMINGTON-GOULD CORPORATION . . . ROCHESTER

TENNESSEE CORPORATION . . . . . NEW YORK
TEXAS GULF SULPHUR COMPANY . . . NEW YORK
THEW SHOVEL COMPANY . . . . . LORAIN
THOMPSON PRODUCTS, INC. . . . . CLEVELAND
TIMKEN-DETROIT AXLE COMPANY . . . . DETROIT
TIMKEN ROLLER BEARING COMPANY . . . CANTON
TITAN METAL MANUFACTURING COMPANY BELLEFONTE
TITEFLEX, INC. . . . . NEWARK
TOKHEIM OIL TANK AND PUMP COMPANY FORT WAYNE
TROJAN POWDER COMPANY . . . . . ALLENTOWN
TWIN DISC CLUTCH COMPANY . . . . . RACINE

UNION CARBIDE AND CARBON CORP. . . NEW YORK
UNION METAL MANUFACTURING COMPANY . CANTON
UNION SWITCH & SIGNAL COMPANY . . SWISSVALE
UNITED AIRCRAFT CORPORATION . . EAST HARTFORD
UNITED-CARR FASTENER CORPORATION CAMBRIDGE
UNITED CHROMIUM, INC. . . . . NEW YORK
UNITED ENGINEERING & FOUNDRY COMPANY . . . . . PITTSBURGH
UNITED STATES RUBBER COMPANY . . . NEW YORK

VICKERS, INC. . . . . DETROIT
VICTOR MANUFACTURING & GASKET CO. . . CHICAGO
VICTORY PLASTICS COMPANY . . . . . HUDSON

WALTERS MANUFACTURING COMPANY . . OAKMONT
WALWORTH COMPANY . . . . . NEW YORK
WARNER ELECTRIC BRAKE MANUFACTURING COMPANY . . . . . BELOIT
WARNER & SWASEY COMPANY . . . . CLEVELAND
WARREN WEBSTER & COMPANY . . . . CAMDEN
WATERBURY COMPANIES . . . . . WATERBURY
WATERBURY FARRELL FOUNDRY & MACHINE COMPANY . . . . . WATERBURY
WAUKESHA MOTOR COMPANY . . . . WAUKESHA
WEATHERHEAD COMPANY . . . . . CLEVELAND
WEIRTON STEEL COMPANY . . . . . WEIRTON
WESTERN ELECTRIC COMPANY . . . . NEW YORK
WESTINGHOUSE AIR BRAKE COMPANY . WILMERDING
WESTINGHOUSE ELECTRIC CORPORATION . PITTSBURGH
WHEELING STEEL CORPORATION . . . WHEELING
WHITE MOTOR COMPANY . . . . . CLEVELAND
WILLYS-OVERLAND MOTORS, INC. . . . . TOLEDO
WINCHESTER REPEATING ARMS COMPANY . NEW HAVEN
WINTER-WEISS COMPANY . . . . . DENVER
WIREMOLD COMPANY . . . . . HARTFORD
WISCONSIN MOTOR CORPORATION . . . MILWAUKEE
WOOD COMPANY, R. D. . . . . PHILADELPHIA
WORDEN-ALLEN COMPANY . . . . . MILWAUKEE
WORTHINGTON PUMP & MACHINERY CORPORATION . . . . . HARRISON
WYCKOFF STEEL COMPANY . . . . . PITTSBURGH

YORK CORPORATION . . . . . YORK
YOUNG SPRING & WIRE CORPORATION, L. A. . DETROIT
YOUNGSTOWN SHEET & TUBE COMPANY YOUNGSTOWN

ZENITH OPTICAL COMPANY . . . . HUNTINGTON

Atomic Energy

ATOMIC ENERGY PROGRAM

A program is now underway to expand the Nation's atomic-energy facilities to dwarf the $2,000,000,000 wartime plants that produced the first atomic bomb.

The scope of plans, some already in the construction stage, to enlarge present atomic installations was revealed by the Atomic Energy Commission in formal announcements during last year.

Added together, the Commission's announcements reveal a gigantic program, threading the Nation with new installations, enlarging the old ones, making them all permanent, and feeding them with the output of 3,000 prime and subcontractors and major suppliers.

NEW ATOMIC WEAPONS

The U.S. is producing new atomic weapons from both uranium and plutonium, David E. Lilienthal, chairman of the Atomic Energy Commission, told the American Society of Mechanical Engineers at Atlantic City recently. Security prevented Mr. Lilienthal from explaining whether the new weapons are bombs or represent a new military application of nuclear fission.

The same week Prof. John A. Wheeler, nuclear physicist at Princeton who played a major rôle in the development of the first bomb, outlined the possibility of a new type of fission in which the energy liberated would be fifty per cent greater than that released in the explosion of the atomic bomb.

RADIOACTIVE HAZARDS

Greatly advanced developments in science during the war brought about the discovery of new elements, and the newly acquired radioactive substances have greatly increased the need for alert industrial medicine and hygiene, Dr. R. Emmet Kelly, of St. Louis, Mo., medical director of Monsanto Chemical Company, stated recently. Dr. Kelly said that health problems associated with the Nation's newer technology have emphasized the need for more immediate physiological and biological investigations.

He stressed that radioactive materials can be manufactured, shipped, and handled safely and that to date the record has been excellent. He warned, however, that as the use of the substances becomes more widespread, greater danger may exist through complacency and lack of appreciation of their hazards.

The deleterious effect of radioactive materials on humans is produced by setting up destructive ionizing reactions in the tissue. The response varies with the type and amount of exposure. Damage to the germinal cells, the bone marrow, and the lymphatic tissues, and the occurrence of malignant changes comprise the conditions to be expected and guarded against.

NEW ATOMIC PROGRESS

The Los Alamos, N. Mex., experimental station of the Atomic Energy Commission has revealed that it has been found possible to use pure plutonium—a man-made element unknown a few years ago—to operate a relatively small reactor or "pile," without a moderator to slow down the fast neutrons.

ATOMIC PROVING GROUND

A bloody battlefield a little less than four years ago, Eniwetok Atoll, isolated in the vast stretches of the mid-Pacific, is the site of a great proving ground for new atomic weapons and more peaceful applications of nuclear power. A joint release from the Atomic Energy Commission, the State Department, and the National Defense Establishment said that the native inhabitants, some 145 in number, will be moved elsewhere and the entire area closed to ships, planes, and all visitors.

Construction, which has already begun, is in the hands of the armed forces, with Lieut. Gen. John E. Hull, Commander of Army Forces in the Pacific, coördinating the work of the Army, Navy, and Air Force.

$615,000 FOR ROCHESTER

The Atomic Energy Commission recently approved expenditure of $615,000 to provide a center at the University of Rochester, N. Y., for training doctors and technicians in meeting problems of atomic-energy development.

The money will be used, the Commission said, to build and equip a 6-story medical and biological training and research center.

Two floors of the building are to be devoted to a Commission-financed educational program for medical doctors, biologists, and health physicists.

There the doctors will receive postgraduate training in treatment of radiation sickness, use of radioisotopes for tracer studies and therapy, and instruction in a variety of topics including pharmocology and toxicology of radioactive materials and principles of shielding.

ATOMIC BULLETS

Streams of 380,000,000-volt atomic bullets, by far the greatest energies ever controlled by man, are being produced in the University of California's new giant cyclotron. The energy is nearly twice that released in the fission of a uranium atom.

Invisibly minute particles propelled by such forces will pass through the densest form of matter, the atomic nucleus, like light through a pane of glass. But when they hit in exactly the right way, they split the nuclei of several elements high in the atomic table into several pieces, just as the U-235 atom is split by a slow neutron. For the present, this has no bearing on the production of atomic energy since no chain reaction is begun.

NEW COSMIC RAY THEORY

A new theory on the origin of cosmic rays, whose energies dwarf that produced by nuclear fission, was advanced by two Harvard University scientists. Drs. Donald H. Menzel and Winfield W. Salisbury suggested that the rays might be a local phenomenon created "only a few million miles" from the earth's surface.

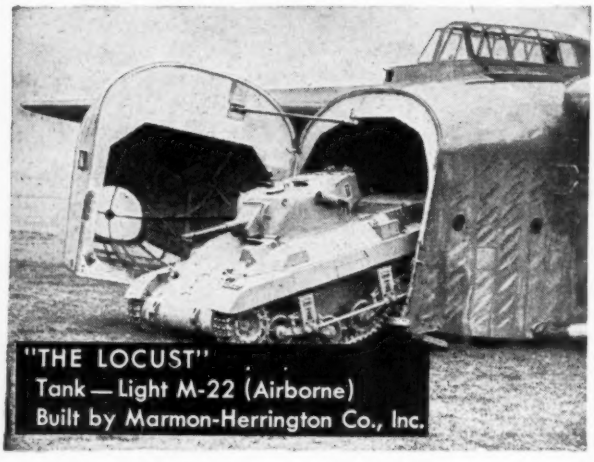
Dr. Menzel reported that the theory suggested itself in observations on microwave experiments carried on by the two scientists in connection with radio noise traced to solar disturbances. Their findings suggest that cosmic rays are formed when radio waves of tremendously long wave lengths escape from solar disturbances and penetrate a field of gaseous, electrically charged particles.

ATOMIC MEDICINE COURSE

More than twenty of the country's medical schools accepted an invitation to send representatives to the 5-day intensive course on medical aspects of atomic explosion which opened at the Army Medical Center, Washington, D. C., on January 12, 1948.

Sponsored by the Armed Forces Special Weapons Project, medical services of the armed forces, and the Veterans Administration, the primary purpose of the training program was to portray the various types of injury produced by atomic blast and to outline fundamentals of treatment. Students were drawn chiefly from the Army, Air Force, Navy, Public Health Service, Veterans Administration, and other Federal agencies.

The course did not take up in detail the technical aspects of radioactivity. Because it was only five days in length, it was concerned only with the fundamentals of radiation hazards, diagnosis, and treatment.


"THE LOCUST"
Tank — Light M-22 (Airborne)
Built by Marmon-Herrington Co., Inc.

MILITARY VEHICLES
of all Types

Combat Tanks ★ Armored Cars ★ Scout Cars ★ Reconnaissance Cars ★ Officers Cars ★ Ambulances ★ Mobile Machine Shops ★ Artillery Tractors for guns of all sizes ★ High-speed Track Laying Artillery Tractors ★ Captive Balloon Winches ★ Air Field Service Tractors ★ Airplane Crash Trucks ★ Fire Equipment ★ Airplane Wrecking Trucks Mobile Aircraft Machine Shops ★ Mobile Oxygen Generator Units ★ Mobile Water Purification Units ★ Air Field Rotary Snow Removal Equipment ★ Air Field Fuel Servicing Trucks.

We are Specialists in the Design and Production of Military Transportation Equipment

MARMON-HERRINGTON CO., INC.

MANUFACTURERS OF ALL-WHEEL-DRIVE VEHICLES
AND HIGH-SPEED TRACK-LAYING VEHICLES

INDIANAPOLIS, INDIANA, U.S.A.

Purveyors to U.S. Army, U.S. Navy, U.S. Marine Corps and Many Foreign Governments

Guided Missiles

NEPTUNE ROCKET

The Neptune rocket, designed to carry research instrumen to a height of 235 miles, farther than ever before attempte has been built by the Glenn L. Martin Company, for the Nav The Neptune is about one-third the weight but about the sam length as the German V-2 and can be easily distinguished fro the V-2 because of its slender appearance. The nosepiece ca carry from 100 to 2,000 pounds of measuring instruments. The rocket is launched from a vertical position.

TESTS WITH THE V-2

The V-2 rockets being launched at White Sands Proving Ground, N. Mex., are seeking to explore further the physica mysteries of the upper atmosphere by an intricate assembly o instruments installed in the missiles. With these new instrument it is hoped to obtain scientific data which might be incorporate in the future development of supersonic aircraft, guided missiles electronic equipment, and weather forecasting.

The firings will carry out six important phases of an exten sive upper-atmosphere research program. These are photographi determination of the missile's ascent; photographic studies o the upper atmosphere and the action of the parachute used i lowering the instrument container; measurement of the distribu tion of ionized particles in the ionosphere and their effect o radio and radar waves; determination of the point of voltag breakdown on electrical equipment in the V-2 war head; sky brightness at extreme altitudes; and measurement of tempera tures and pressures at high altitudes.

The instruments employed in the tests are installed in a sectio behind the V-2's war head. This section will be automatically ejected from the rocket at the height of its trajectory. Specia containers and parachutes will be used in returning the delicat measuring instruments and their recorded observations to earth

In some missiles, seven electrified aërial cameras stripped o all but essential controls and loaded with color film will be use to supply vital data and complete second-by-second coverage o the rocket's flight. They will be placed in the midsection o the rocket so that the cameras can photograph the rocket's tai surfaces and the earth below as well as the horizon from rocke take-off to rocket zenith. Containers housing the cameras will be ejected at or near the zenith of the trajectory and will be re covered by means of parachutes. Information thus obtained wil provide additional facts on the flight characteristics of the missile itself as well as helping to correlate and interpret other data obtained during the firing.

In addition, one high-speed motion picture camera will photo graph the action of the parachutes which lower the containers following their ejection from the rocket. To obtain color com parison of the sky at rocket zenith, one of the cameras loaded with color film will photograph the inner colored surfaces of the parachutes.

Especially important to electronic engineers will be the measure ments of the distribution of ionized particles in the ionosphere and the resultant effect on radio and radar waves. It is an estab lished principle of optical physics that when light passes from a less dense to a more dense medium its speed is reduced and it is refracted through a longer path. Radio waves passing from the earth boundaries of low electrical density into the stratosphere regions of high ionization activity are similarly affected.

Ionosphere data will be obtained through close coördination

Wherever you Employ Magnets, Check with us on the Advantages of using

ARNOLD

PERMANENT MAGNETS

As electrical constituents go, permanent magnets are relatively new. They made tremendous advances within the past decade, especially in the communications and aviation industries, and in the general fields of instruments, controls, meters and mechanical holding devices.

Many of these uses were problems that just couldn't be solved until permanent magnet materials were developed to do the job—a work of pioneering to which Arnold contributed a heavy share. Many other applications were those where permanent magnets supplanted older materials because of their inherent ability to save weight, size and production time, as well as greatly improve the performance of the equipment.

To these advantages, Arnold Permanent Magnets add another very important value—standards of quality and uniformity that are unmatched within the industry. Arnold Products are 100% quality-controlled at every step of manufacture. What's more, they're available in all Alnico grades and other types of magnetic materials, in cast or sintered forms, and in any shape, size or degree of finish you need.

Let's get our engineers together on *your* magnet applications or problems.

THE ARNOLD ENGINEERING CO.

Subsidiary of

ALLEGHENY LUDLUM STEEL CORPORATION

147 East Ontario Street, Chicago 11, Illinois

Specialists and Leaders in the Design, Engineering and Manufacture of PERMANENT MAGNETS

W&D 1296

HEIL
Quality
PRODUCTS

Bodies & Hoists
Transport Tanks
Road Machinery
Heating Equipment
Dehydrators
Bottle Washers
Water Systems

Serving the world with equipment for

1 Better Foods
2 Better Homes
3 Better Roads
4 Better Transportation

A-11

THE HEIL CO.
GENERAL OFFICES • MILWAUKEE 1, WISCONSIN

ARMSTRONG CORK COMPANY

Manufacturers of over 360 different products for home and industry

ARMSTRONG CORK COMPANY
Lancaster, Pennsylvania

between equipment on the ground and in the missile. Two synchronized radio transmitters, located on the ground, will emit pulses of electromagnetic energy at two widely different frequencies. In operation, the first pulse triggers a radar beacon while the second pulse modifies the transmission from the beacon and is slowed down as it enters the ionosphere. The amount it is slowed down is reported by the beacon and recorded on photographic film. The greater the number of electrons in the region, the greater the delay of this second pulse.

Results obtained with a preliminary V-2 test on November 21, 1946, indicated the lower boundary of the ionosphere was ragged and did not present a good, mirrorlike reflecting surface. As this region is constantly in motion, radio waves transmitted from distant radio stations are reflected irregularly and "fading" or "blasting" results in home radio receivers.

Electrical equipment within the war head is protected against low-pressure voltage breakdown, known as "arc-over," by a pressurization system. "Arc-over" is a spark discharge, similar to that occurring in a neon sign, which is caused by low pressure. Equipment placed outside the war head, however, may fail to function because of the partial vacuum which may exist. Since it is essential to know what voltage is safe at high altitudes, electrodes of peculiar shape have been placed in the control chamber of the rocket and a varying voltage will be applied periodically between them. The voltage at which "arc-over" occurs will be radioed back to the ground.

In the design of a parachute to lower the equipment and data safely to earth, the primary consideration is durability, since the velocity attained by the container might reach a mile per second before the parachute opens. Tension will be measured in the cords of the parachute during its fall, and the readings will be transmitted by an extremely lightweight (17-ounce) radar beacon installed within the container. This beacon, designed and built at the Cambridge Field Station, also assists the ground radar engineers in tracking the container and fixing the position where it strikes the ground.

Routine details of the firings are handled with the Ordnance Department preparing and launching the rocket, the Signal Corps testing ground communication links for synchronizing the ground stations and radar equipment, and the Navy Department supplying telemetering equipment to transmit data back to the ground from the Air Force instruments in the rocket.

"STOOGE" ROCKET

The "Stooge," first radio-controlled rocket missile developed in Great Britain, is considered a possible defense against bombers carrying atomic bombs. Four external rockets are boosters for take-off. The weapon has a range of about 8 miles and a speed of over 500 miles an hour.

NAVY'S GUIDED MISSILE PROGRAM

Guided missiles of all types are being fired at sea from warships of varying classes in a continuing program to adopt the weapon to strategic long-range naval bombardment.

Rear Adm. Daniel V. Gallery, Assistant Chief of Naval Operations, said that the Navy, through the V-2 firing at sea, has proved it is capable of making a transoceanic weapon out of a missile having a range of only several hundred miles.

"While practically all the basic problems in the guided-missile field are encountered and are under study by all the services," Admiral Gallery said, "the requirements of the end products are obviously different. Guided missiles will give the Navy offensive power as never before. What it boils down to is that not only does the Navy need guided missiles, but guided missiles need a navy."

Actually, the Admiral pointed out, the Navy is devoting a greater percentage of its research and development funds to guided missiles than to any other category of research.

Which is really Dorothy Lamour?

CURRENTLY STARRING IN THE PARAMOUNT PRODUCTION "ROAD TO RIO" (See answer below)

Spark plugs also look alike, but

AUTO-LITE SPARK PLUGS

are *"Ignition Engineered"*

Since most spark plugs look alike, it's hard to tell which is best from outside appearance—just as it's difficult to tell which of the pictures above is really Dorothy Lamour. To make sure you get the best, ask for Auto-Lite Spark Plugs —they're *ignition engineered.* This means they're designed by the same engineers who design the entire electrical life-line for many of America's finest cars—from battery to coil to distributor to spark plug. Score yourself 100% if you picked the girl at the right as the real Dorothy Lamour, beautiful and talented actress starring now in Paramount's thrilling new hit "Road to Rio." At left is Mrs. Blanche Karlan, housewife of Brooklyn, N. Y., who looks so much like Miss Lamour that strangers frequently ask for her autograph on the street.

You'll be 100% right, too, if you switch to Auto-Lite Spark Plugs, equipment on many leading makes of cars.

Switch to AUTO-LITE

MONEY CANNOT BUY A BETTER SPARK PLUG

Toronto, Ontario — THE ELECTRIC AUTO-LITE COMPANY — Toledo 1, Ohio

Listen to Auto Lite's radio program, YOUR THURSDAY NIGHT MEETING starring Dick Haymes, Gordon Jenkins' Orchestra, Thursday 9:30 P. M., E. T. CBS.

Precision Scale for Bulky Goods

When industry has need for precision weights in bulky commodities the scale to use is the EXACT WEIGHT Shadograph Model #4126. Bulky goods generally obstruct the dial on most scales so Model #4126 was designed and built to overcome this fault. This scale handles 12 lbs. at capacity; dial markings are 1 oz. over and underweight (2-inch travel); platter 9" x 9" and two scoop sizes, 8" x 15" and 10½" x 19". Sensitivity to 1/50 oz. Metric specifications if preferred. Write for further details.

★ ★ ★

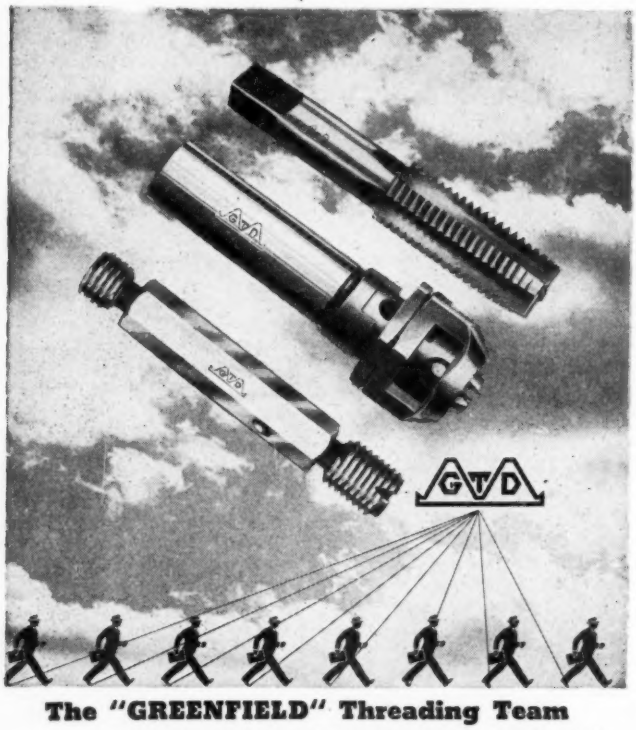
INDUSTRIAL PRECISION

Exact Weight Scales

THE EXACT WEIGHT SCALE COMPANY

West Fifth Avenue, Columbus 12, Ohio

Dept. W, 783 Yonge St., Toronto 5, Canada



The "GREENFIELD" Threading Team

From the metallurgist, who tests the steel from which "Greenfield" Taps, Dies and Gages are made, to the field engineer who helps the user get the most production out of "Greenfield" Tools—there is a highly trained organization of "Greenfield Men". Together they make the "Greenfield" Threading Team an outstanding contribution to the efficiency of the metal-working industry.

GTD GREENFIELD

GREENFIELD TAP and DIE CORPORATION · GREENFIELD · MASSACHUSETTS

Book Reviews

Review Staff

BRIG. GEN. DONALD ARMSTRONG, *military historian, lecturer, author, New York, N. Y.*

COL. GEORGE S. BRADY, *consulting engineer, author, editor, Washington, D. C.*

F. W. FOSTER GLEASON, *military historian, ordnance analyst, editor, Washington, D. C.*

LIEUT. COL. CALVIN GODDARD, *small-arms authority, Tokyo, Japan.*

MAJ. MELVIN M. JOHNSON, JR., *automatic arms expert, inventor, author, Boston, Mass.*

BRIG. GEN. R. H. SOMERS, *engineer, ballistician, author, editor, Dover, N. H.*

COL. THOMAS K. VINCENT, *artillerist, engineer, author, Greisheim, Germany.*

BOMBER OFFENSIVE. By Sir Arthur Harris. New York: The Macmillan Company. 288 pp. $2.75.

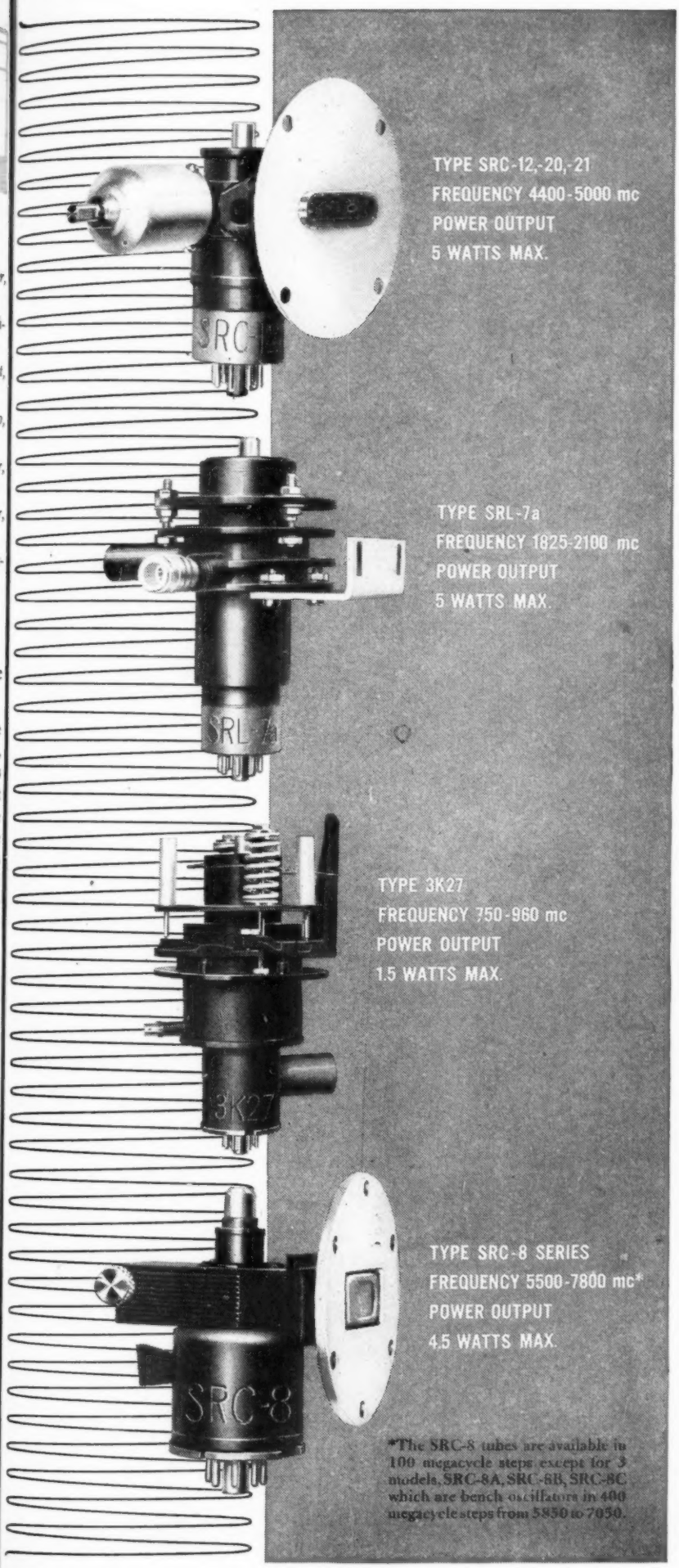
AT a time like this when we are all in doubt concerning the nature of war of the future and how to protect ourselves from it, Marshal of the Royal Air Force Sir Arthur Harris has given us a book which presents an authentic picture of the development and application of strategic bombing during World War II. He believes that strategic bombing was the deciding factor in the European phase of that conflict. He also believes that many lives of allied soldiers, sailors, and airmen could have been saved if the value of such bombing had been properly appreciated by those who made the high-level decisions and if we had provided larger strategic air forces sooner.

Sir Arthur has always had a reputation for being outspoken on the use of air power. In his book we get frank opinions. He does not hesitate to place blame where it is justified in his opinion; neither does he fail to give adequate credit to the airmen of his Bomber Command which incurred casualties of about 75,000 out of a total aircrew strength of 125,000. He also expresses the greatest admiration for the personnel of the American Eighth Air Force which operated alongside and with the Bomber Command from 1942 to 1945.

In the chapter entitled "Getting the Weapons" he discusses aircraft, guns, bombs, mines, pyrotechnics, and radar bomb-aiming equipment.

The following is quoted as an example of the close Ordnance coöperation between the RAF and the American Air Forces operating in Europe. "I had therefore warned the appropriate authorities that the time might come when we should need an enormously larger supply of heavy-case high-explosive bombs than before. . . . But in October 1944 I found that my warning had been disregarded. For the last six months of the war we were therefore faced with a desperate shortage of high-explosive bombs and had to live all the time from hand to mouth, doing our best with our own supply and with what the Americans could let us have in spite of their own similar shortage."

This book is highly recommended to any one who is interested in understanding what strategic bombardment accomplished during World War II.—PHILIP SCHWARTZ.



TYPE SRC-12,-20,-21
FREQUENCY 4400-5000 mc
POWER OUTPUT
5 WATTS MAX.

TYPE SRL-7a
FREQUENCY 1825-2100 mc
POWER OUTPUT
5 WATTS MAX.

TYPE 3K27
FREQUENCY 750-960 mc
POWER OUTPUT
1.5 WATTS MAX.

TYPE SRC-8 SERIES
FREQUENCY 5500-7800 mc*
POWER OUTPUT
4.5 WATTS MAX.

*The SRC-8 tubes are available in 100 megacycle steps except for 3 models, SRC-8A, SRC-8B, SRC-8C which are bench oscillators in 400 megacycle steps from 5850 to 7050.

new klystron tubes

NOW AVAILABLE FOR MICROWAVE RELAYS

■ Four Sperry Reflex Klystron oscillators for microwave relay systems are now available for commercial use. These Klystrons can be used either as transmitting types or local oscillators. They can also be used in the laboratory as bench oscillators in the development of microwave relay systems.

■ With these new Klystron tubes, relay techniques are simplified and the mechanical problems associated with lower frequency relay links are overcome.

■ Other Sperry Klystrons are available in the frequency range from 500 to 12,000 megacycles. Our Industrial Department will gladly supply further information.

SPERRY

SPERRY GYROSCOPE COMPANY

DIVISION OF THE SPERRY CORPORATION, GREAT NECK, N. Y.

NEW YORK · CLEVELAND · NEW ORLEANS
LOS ANGELES · SAN FRANCISCO · SEATTLE

AMERICAN CHAIN & CABLE
BRIDGEPORT • CONNECTICUT

★
ACCO PRODUCTS
•
FOR INDUSTRY TRANSPORTATION AGRICULTURE
★

ACCO

TRADE MARK

In Business for Your Safety

- **CHAIN** .. Weed Tire Chains • Welded and Weldless Chain and Attachments — **AMERICAN CHAIN DIVISION**
- **CABLE** .. Tru-Lay Preformed Wire Rope and Crescent Non-Preformed Wire Rope — **AMERICAN CABLE DIVISION**
- **AUTOMOTIVE & AIRCRAFT** .. Cable, Controls, Fittings • Tru-Stop Brakes for Trucks and Buses — **AUTOMOTIVE AND AIRCRAFT DIVISION**
- **CUTTING MACHINES** .. Wet Abrasive Cutting Machines • Nibbling Machines — **ANDREW C. CAMPBELL DIVISION**
- **CHAIN BLOCKS** .. and Trolleys — **FORD CHAIN BLOCK DIVISION**
- **WIRE ROPE** .. Lay-Set Preformed Wire Rope • Nonparell Non-Preformed Wire Rope — **HAZARD WIRE ROPE DIVISION**
- **PRESSURE GAGES** ... **HELICOID GAGE DIVISION**
- **AUTOMOTIVE EQUIPMENT** .. for garages and service stations — **MANLEY MANUFACTURING DIVISION**
- **WIRE** .. Welding Wire, Shaped Wire, Manufacturer's Wire, Chain Link Fence — **PAGE STEEL AND WIRE DIVISION**
- **LAWN MOWERS** .. Lawn Cleaners — **PENNSYLVANIA LAWN MOWER DIVISION**
- **VALVES** .. Bronze, Iron & Cast Steel — **READING-PRATT & CADY DIVISION**
- **AUTOMATIC REGULATING VALVES** — **d'ESTE DIVISION**
- **CASTINGS** Steel • **READING STEEL CASTING DIVISION** Malleable Iron • **AMERICAN CHAIN DIVISION**
- **HOISTS AND CRANES** .. Wright Chain Hoists, Electric Hoists, Cranes — **WRIGHT MANUFACTURING DIVISION**
- **BOLTS AND NUTS** .. Lag Screws and Forgings — **THE MARYLAND BOLT AND NUT COMPANY**
- **SPRINGS** .. Owen Springs and Units for Mattresses and Furniture — **OWEN SILENT SPRING COMPANY, Inc.**
- **HARDNESS TESTERS** .. ("Rockwell") — **WILSON MECHANICAL INSTRUMENT CO., Inc.**

In Canada .. **DOMINION CHAIN COMPANY, *Limited***
In England .. **BRITISH WIRE PRODUCTS, *Limited***
THE PARSONS CHAIN COMPANY, *Limited*

where metal is a hazard

Bauer

MAGNETIC SEPARATORS

Bauer Triple-Air-Gap and Single-Air-Gap Separators in spouts and chutes . . . . Bauer Portable Separators over picking tables and conveyor belts . . . . are used in processing operations for removing tramp-iron and ferrous particles from practically all sorts of granular and liquid materials. Exclusive features and great magnetic force give Bauer Separators extraordinary efficiency.

These magnetic separators were developed to uphold the Bauer reputation for manufacturing excellent processing equipment . . . . grinding, crushing, decorticating, pulping, cleaning, blanching, and roasting machinery.

Full particulars on Bauer Magnetic Separators will be gladly sent upon request

THE BAUER BROS. CO.

1787 Sheridan Avenue
SPRINGFIELD
OHIO

Book Reviews

THE FIRST CAPTAIN—THE STORY OF JOHN PAUL JONES. By Gerald W. Johnson. New York: Coward-McCann, Inc. 312 pp. $3.50.

MR. JOHNSON'S presentation of the life of John Paul Jones has as its main thesis that Jones is, in a very real sense, the one man who can be called "the father of the American Navy." He does a good job of proving his point—showing that Jones was not only a splendid seaman, fighter, and leader of men but just about the earliest professional naval officer in the modern sense of that term.

The book paints a really interesting picture of conditions in Philadelphia and Paris during the years of the Revolutionary War, and the author's description of the active days of Captain Jones' war service is very good. But in writing of the somewhat obscure prerevolutionary years of Jones' life, he indulges in far too much speculation and some "padding."

Probably the almost unbelievable inanity of the Continental Congress, the venality of many politicians, and the poltroonery of not a few others well earn the rather florid sarcasm of Johnson. However, this reviewer believes that "The First Captain" would be even more impressive and more readable if it had been confined to some 240 pages.—F. W. F. GLEASON.

THE STUDY OF MISSILES RESULTING FROM ACCIDENTAL EXPLOSIONS. By Col. Crosby Field. New York: The American Society of Mechanical Engineers. 61 pp. $1.50.

ONE of the most noteworthy yet least heralded accomplishments of the Industry-Ordnance team in World War II was its phenomenal safety record in the manufacture, storage, and shipment of explosives. Credit for this notable achievement belonged in large part to the Explosives Safety Division of the Ordnance Department of the Army.

That division was established under the direction of Lieut. Gen. L. H. Campbell, Jr., Chief of Ordnance, by Col. Francis H. Miles, Jr. Col. Crosby Field, author of this study, was deputy chief of the division from its inception and devoted a great part of his energy and ability to the study of missiles or fragments resulting from accidental detonations of military high explosives.

In this text, the author describes a novel procedure for finding the cause of accidental explosions. This procedure rests primarily upon the completeness of the study of all the missiles resulting from the explosion and also the study of one or more missile maps on which the probable trajectories of the most important missiles have been plotted.

Here, for the first time, Colonel Field presents in a thoroughly documented and illustrated treatise the procedures and techniques which were of such great value in achieving Industry-Ordnance safety in World War II.

As a result of this type of study, the Industry-Ordnance team was able to establish its phenomenal safety record. We should not forget that it was truthfully claimed in the midst of the greatest of all wars that one was safer in an explosives plant in the United States than he was in his own home. What a phenomenal safety record that was! It must not soon be forgotten—nor must the tireless efforts of the men in industry and in the services who were responsible for it. Among these the name of Crosby Field holds deservedly high place.—L. A. COOD.

ALSOS. By Samuel A. Goudsmit. New York: Henry Schuman, Inc. 259 pp. $3.50.

IN the first months of 1945, senior Air Force officers in the European theater of war learned of the existence of a very secret scientific mission. It was operating in northern Europe, but little was generally known of its specific goals. "Alsos" was the code

The Ordnance Book of the Month

HORNED DEATH

By John F. Burger

The true and exciting account of the Africa-born author-adventurer's 40-year sojourn in places where survival was the first law. A big-game hunter, Mr. Burger most persistently stalked the murderous Cape buffalo and bagged over 1,000 specimens of this "horned death." Every outdoor-lover will want this book. Retail $6.50. To members $5.52.

AIRBORNE WARFARE

By Maj. Gen. James M. Gavin

America's leading student of airborne warfare offers his opinions, based on broad research and experience, on what will happen in the future. "Airborne Warfare" covers every Allied airborne campaign of World War II, using them as a basis for estimating the weapons, equipment, and tactics of the future. Retail price $3.00. To members $2.55.

WAR AS I KNEW IT

By Gen. George S. Patton, Jr.

Gen. George Patton never ducked a fight or pulled a punch in his life—and his brilliant book on his military life, on his campaigns in World War II, his estimates of the men and the units he fought with (and against), his criticisms of the strategy and tactics of his superiors, have the ring of honesty—and the attraction of keen observation and fine writing. Retail price $3.75. To members $3.19.

OR FORFEIT FREEDOM

By Robert Wood Johnson

A top industrialist explains his plan for labor-management coöperation. Retail price $2.50. To members $2.12.

WEAPONS OF WORLD WAR II

By Maj. Gen. G. M. Barnes

A handbook for the men who designed, produced, or used American matériel. Retail price $7.50. To members $6.25.

HATCHER'S NOTEBOOK

By Maj. Gen. Julian S. Hatcher

The distillation of years of experience with small-arms testing and design. Retail $5.00. To members $4.25.

RECOMMENDED

	Retail	*To Members*
THE NEW SLAVERY *By* Hoffman Nickerson	$3.50	$2.97
JANE'S FIGHTING SHIPS, 1944-45 (Corrected to April 1946)	19.00	16.15
MATERIALS HANDBOOK *By* George S. Brady	7.00	5.95
THE INDUSTRY-ORDNANCE TEAM *By* Lieut. Gen. L. H. Campbell, Jr.	5.00	4.00
A REPORT ON GERMANY *By* Lewis H. Brown	3.00	2.55
COMPANY COMMANDER *By* Charles B. MacDonald	3.00	2.55
HOUSE DIVIDED *By* Ben Ames Williams	5.00	4.25
CONQUER: THE STORY OF NINTH ARMY	4.50	3.82

THE NEW YORK ORDNANCE DISTRICT IN WORLD WAR II

By Col. Chester Mueller

A basic study of the operation of America's decentralized procurement system. Retail $5.00. To members $4.50.

ORDNANCE BOOK SERVICE
705 Mills Building, Washington 6, D. C.

Please send me, postpaid, the following books:*

.....

.....

.....

Name .....
(please print)

Address .....

City, Zone, State .....

**I certify that I am a member of the A.O.A.*

AMERICAN ORDNANCE ASSOCIATION
705 Mills Building **Washington 6, D. C.**

Explosives and blasting supplies for blasting work on airports, highways, harbor channels and demolition operations.

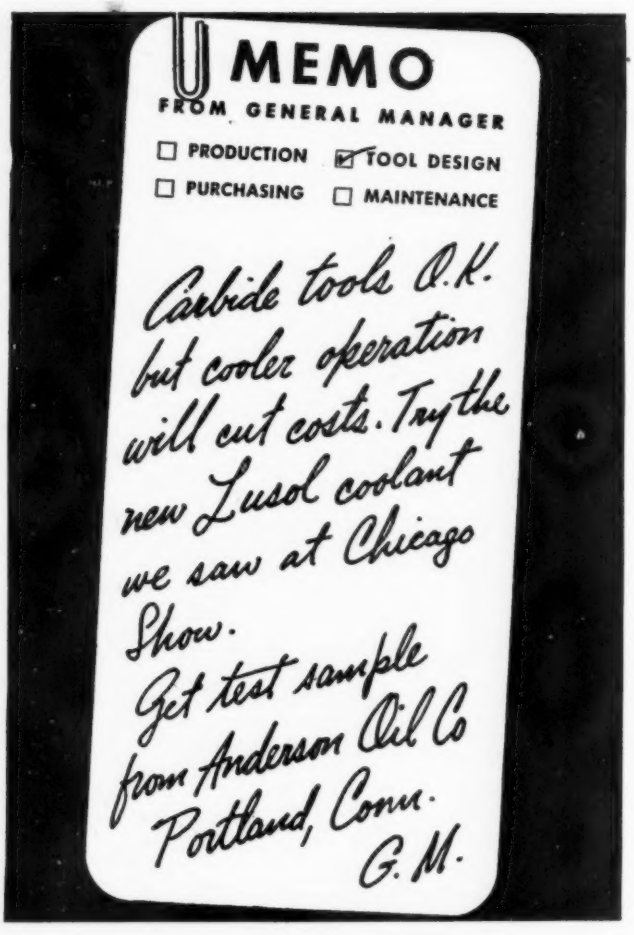
CHEMICALS ATLAS EXPLOSIVES

ATLAS

POWDER COMPANY

Wilmington 99, Delaware

Industrial Explosives — Coated Fabrics
Blasting Supplies — Activated Carbons
Product Finishes — Chemicals


MEMO
FROM GENERAL MANAGER
☐ PRODUCTION ☑ TOOL DESIGN
☐ PURCHASING ☐ MAINTENANCE
Carbide tools O.K. but cooler operation will cut costs. Try the new Lusol coolant we saw at Chicago Show.
Get test sample from Anderson Oil Co Portland, Conn.
G. M.

Book Reviews

name for the mission; it was headed by Dr. Goudsmit, a professor of physics at Northwestern University.

The scientists attached to Alsos were to determine how far the Nazis had progressed in the development of an atom bomb. The race to build such a bomb was started in December 1938 when Otto Hahn, a German scientist, discovered the principle of uranium fission and another German published the first paper on the chain-reacting pile.

The Germans began their research on uranium two years before we did, and it was feared that one of Hitler's vengeance weapons was an atom bomb. Early in 1945 Dr. Goudsmit's investigations in France and Germany had progressed to the point where he became satisfied that the Nazis were unable to develop a practical A-bomb.

Professor Goudsmit relates the experiences of some members of the mission while obtaining information from enemy physicists. He analyzes the reasons for the German failure to develop an atom bomb before the Americans did. He believes that the incompetent leaders who were the heads of scientific organizations in Germany during the war were responsible for the failure. He emphasizes lessons applicable to any country which desires to utilize the help of scientists in developing national-defense equipment. "Alsos" is easy to read but does not contain much scientific information.—PHILIP SCHWARTZ.

GUN FUN WITH SAFETY. By G. E. Damon. Huntington: Standard Publications, Inc. 201 pp. $6.

ONE of the few compendiums on the over-all subject of the safe and efficient handling of firearms, this is by far the most comprehensive that this reviewer has ever seen. Many gun books, of course, exist which treat more exhaustively of one or more aspects of the shooting game; but this succeeds in covering most all—even ballistics—without skimping any of them. But the title is open to criticism for the book is far more worth while than is indicated by "fun."

Modern arms, gun care, sights, cartridges, target and game shooting, and competition are well handled. The thing, however, that is stressed throughout is safety and its price, constant vigilance. Some 125 illustrations enrich the book. Appendices covering a shooter's bibliography, state conservation and game laws, and a glossary of gun terms add much of value. It is difficult to conceive of the man or woman who even owns a gun who would not benefit from this volume.—F. W. F. GLEASON.

STRATEGY IN WORLD WAR II—A STRATEGICAL EXAMINATION OF THE LAND OPERATIONS. By Lieut. Col. Alfred H. Burne, D.S.O., R.A. (Ret.). Harrisburg: The Military Service Publishing Company. 91 pp. $1.75.

THE principles of strategy that have been empirically derived from centuries of warfare have been little affected by advancing technology. Colonel Burne bases his analysis of land strategy in the recent war on these age-old principles. His contribution to the subject lies in his emphasis of the part played by elements other than those principles in winning victories.

In World War II, as in the past, leadership, morale, the quality and capability of the troops, plus resources in numbers, weapons, and other logistical factors must be considered in appraising the outcome.

This attempt to include all possible variables in warfare requires far more space for adequate treatment than this small book affords. Nevertheless, in spite of excessive brevity and simplification, this is a useful introduction to the theory of strategy and its application in World War II. After observing the campaigns from Poland to the defeat of Germany and Japan, the reader will agree with Colonel Burne that a commander will ignore the study of strategy at his peril.—DONALD ARMSTRONG.

Peace insurance begins on jobs like this!

Timken Axle-equipped truck-trailer trains like the one below are part of the best peace insurance our country can have.

The axles carry, move and stop this 20-ton load of dies!

Proved and perfected design and material advancements on all types of Axle and Brake assemblies for heavy-duty commercial vehicles assure U.S. military transport of an up-to-the-minute, ready-to-use background of experience. This skill is available in a hurry should the need arise.

Timken Axle is continuing its long-standing policy of devoting its technical laboratories and field experience to help advance commercial and military transport of all types to keep U.S. transport "tops" in the world.

The Accepted Standard — TIMKEN AXLES — TIMKEN D-A CO.

TIMKEN AXLES

THE TIMKEN-DETROIT AXLE CO., DETROIT 32, MICH.
WISCONSIN AXLE DIVISION • OSHKOSH, WIS.
TIMKEN AXLE BRAKE DIVISION • DETROIT 32, MICH.

COST PER HOLE is the important factor to consider when you are selecting the proper drill for *any* job. On this basis you will find that CLE-FORGE High Speed Drills give you maximum results at minimum cost.

The CLEVELAND TWIST DRILL COMPANY
1242 EAST 49TH STREET
CLEVELAND 14

TRADE MARK REG. U. S. PAT. OFF. AND FOREIGN COUNTRIES

30 THOMAS ST., NEW YORK 7 • 2929 EAST GRAND BLVD., DETROIT 2 • 9 NORTH JEFFERSON ST., CHICAGO 6
1902 NORTH FIELD ST., DALLAS 1 • 650 HOWARD ST., SAN FRANCISCO 5 • 2301 EAST 38TH ST., LOS ANGELES 11
E. P. BARRUS, LTD., BRUNEL RD., ACTON, LONDON, W. 3, ENGLAND

APPROVED UNDER NEW
COAST GUARD SPECIFICATIONS-24 OCT., 1947

DAYNITE
SMOKE
FLARE
DISTRESS SIGNAL
Only DAYNITE SIGNALS provide protection day and night—vivid orange smoke visible in broad daylight to patrol planes and cutters PLUS brilliant night flare visible to the horizon and beyond.
★ 1,500,000 Delivered to U. S. Armed Forces. (identified as SIGNAL DISTRESS DAY and NIGHT MARK 13 MOD 0)
★ APPROVED by U. S. Coast Guard, Civil Aeronautics Administration, Air Transport Association, and many Foreign Governments.
★ OBSERVED from aircraft in Official U. S. Coast Guard test—33 miles
★ OBSOLETES pistol-projected, floating and paper-wrapped fireworks type signals
Double duty: combines orange smoke-signal and night flare in opposite ends of watertight steel container. Hand-held.
Safe. Dependable. Visible when overcast would obscure pistol projected or roman-candle star signals.
U. S. Coast Guard
Approval No. 160.023/1/0
31 October, 1947

*DAYNITE T.M. Reg., Patents Applied For
AERIAL PRODUCTS, INC., MERRICK, L. I., NEW YORK

Book Reviews

U. S. Army in World War II: The Army Ground Forces—The Organization of Ground Combat Troops. By Kent Roberts Greenfield, Robert R. Palmer, and Bell I. Wiley. Washington: Government Printing Office. 540 pp. $3.25.

THE three authors of this first volume of the Army's official history have made a very good start on a tremendous task. Some ninety-eight additional volumes are planned to complete the huge work. Of course, even the whole set will not furnish a definitive history, but rather a readily usable fount of research material.

It has been compiled almost entirely from official documents, which are at once the ultimate source and the most difficult to use. The almost unbelievable complication of modern large-scale warfare is quite unconsciously presented by the very difficulty of arranging the record of even this one phase. Though chronology is used as much as is feasible, the swiftly changing war picture offers so many new and challenging aspects that parallels are rare.

For an official compilation it is quite objective; controversial things such as "heavy artillery," "weapons evaluation," and the like are well treated. Ordnance and weapons in general are by no means neglected, but are quite difficult (if not impossible) to find by use of the index.

The volume is a good augury to the student and the reader of military history. While not "easy reading" it offers both interesting and profitable browsing for all.—F. W. F. Gleason.

Lucky Forward. By Robert S. Allen. New York: Vanguard Press. 424 pp. $5.

COLONEL ALLEN has written with pride the story of the Third U. S. Field Army from reactivation to V-E Day. The story centers particularly on the period of command by the late Gen. George S. Patton, Jr., and largely is a portrait of that redoubtable gentleman. The portrait is vivid and admiring, but mostly astounding truth. The Patton legend grows but is not more surprising than the man.

Unfortunately, a word portrait in the General's rough language may mislead readers not familiar with his many facets, one of them a roguish, twinkling eye. His language rolled soldiers unfailingly in the aisles, but he never hoped to be quoted and avoided it when possible. At times he failed.

The author reports accurately the Third Army's pride in the General's insistence upon readiness for new battle, whether with the enemy or the allied brass. The lack of similar readiness in other commands of equal or higher rank is duly lamented. Ample evidence is given to show that Third Army readiness paid off on numerous occasions.

The student of Ordnance will learn no direct lessons from this volume. Three times the word "ordnance" was noted but only twice with a capital O.—T. R. Taber.

The Art of War on Land. By Lieut. Col. Alfred H. Burne, D.S.O., R.A. (Ret.). Harrisburg: Military Service Publishing Company. 205 pp. $2.50.

FOR nearly a century Sir Edward Creasy's "Fifteen Decisive Battles" has held its place as a masterpiece of historical and military study. There is little doubt that Colonel Burne's present book merits to rank with the work of the great lawyer-historian.

In a 30-page synopsis of "the strands, the principles, and the strategy" which forms so much of the art of war, the author lays down the simple rules that he follows in analyzing the fourteen actions which he has selected to form the body of his book. These range from the Battle of Kadesh, 1288 B. C., to the Tunisian campaign of 1943. Alexander's victory at Arbela is the sole representative of the original (Creasy) fifteen.

Burne writes lucidly and—because of its simplicity—in a style easy to follow. Save in one instance—Caesar's invasion of Britain

★ ★ ★ ★ ★ ★

44 YEARS OF
Spicer
SERVICE

UNIVERSAL JOINTS
★ ★ ★
PROPELLER SHAFTS
★ ★ ★
TRANSMISSIONS
★ ★ ★
TORQUE CONVERTERS
★ ★ ★
POWER TAKE-OFFS
★ ★ ★
PASSENGER CAR AXLES
★ ★ ★
PARISH FRAMES
★ ★ ★
CLUTCHES

SPICER MANUFACTURING
Division of Dana Corporation
TOLEDO 1, OHIO

The Backbone of Cost Saving Dimensional Control

THE PRECISIONAIRE is a flow type air gage for measuring true and average diameter, bellmouth, out-of-round for through and blind holes—concentricity, squareness, straightness and parallelism—also many external dimensions. Write for catalog.

If you are manufacturing mechanical elements, close dimensional control will save you assembly time because accurately sized parts fit together quickly. Applied directly at the machine, proper gages save you scrap losses and much machine time. When all the elements of a mechanical assembly are held accurately within tolerance, that assembly gives superior performance in service.

Around Sheffield instruments and gages have been developed some of the most effective dimensional quality control policies in the manufacturing field. Let us send you descriptive literature on cost saving equipment—it may lead to solving your inspection problems.

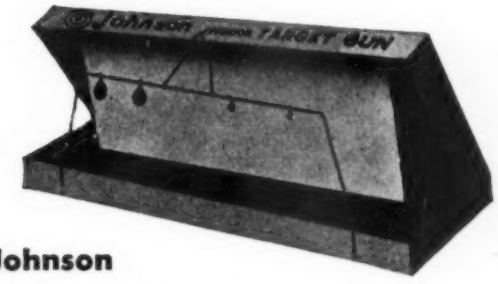
Sheffield's principal products include Gages, Measuring Instruments, Machine Tools, Threading Tools and Contract Services. Standard Gages shipped within 24 hours.

STANDARD GAGES
Sheffield can supply any type of standard or fixed size gage and a wide range of indicating gages for shop checking.

the *Sheffield* corporation
DAYTON 1, OHIO
SHEFFIELD MEASTER CRAFTSMEN
U. S. A.

2704

Shoot INDOORS
—Safely! —Accurately! —Inexpensively!



with the Johnson
Indoor Target Gun

The Johnson Indoor Target Gun is accurate to a degree that will astound you—at indoor ranges it will shoot as close as you can hold with a bench rest! Military sights, adjustable for elevation and windage, and a crisp trigger squeeze make the gun a really fine target device.

IT'S SAFE! The pellet from a Johnson Gun won't break the skin on your hand—or imbed itself in the wall. Shoot it indoors *without worrying* about damage, or ricochets. The packing carton is set up with a curtain which makes a safe, efficient backstop and target frame!

IT'S INEXPENSIVE! The special, polished-steel pellets (65 come with the gun) can be used over and over without loss of accuracy. Extra pellets and parts are available at nominal prices.

IT'S ONLY $15
Order from
THE AMERICAN ORDNANCE ASSOCIATION
705 Mills Building, Washington 6, D. C.

Gun comes to you postpaid, complete with

- Pellets
- Extra propulsion units
- Extra pellet carrier
- Paper targets
- Metal swinging targets
- Backstop and target frame

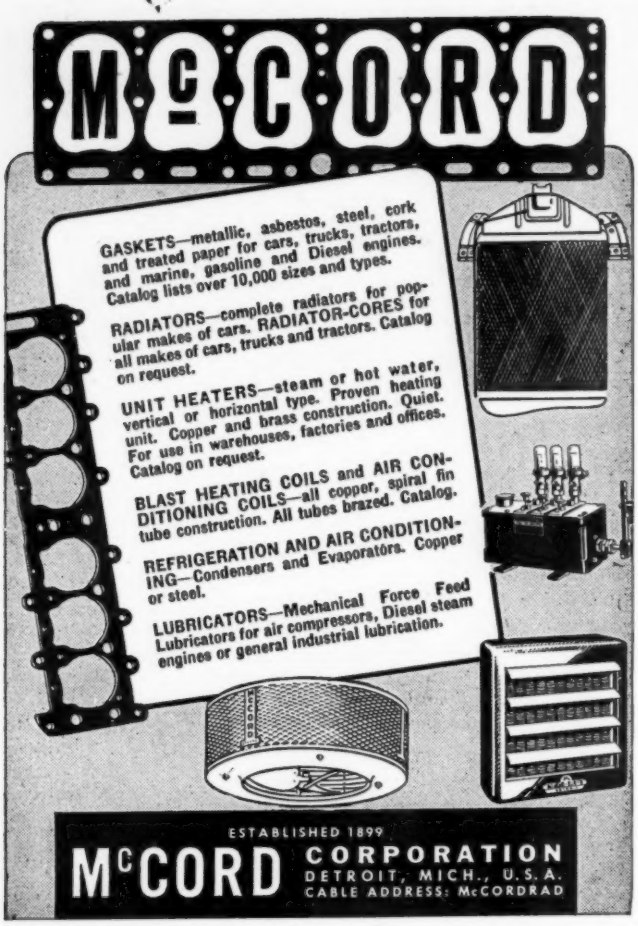
AMERICAN ORDNANCE ASSOCIATION
705 Mills Bldg., Washington 6, D. C.

I enclose $..... Please send me, postpaid, ... Johnson Indoor Target Guns at $15 each.

Name (please print)

Street

City, Zone, State


McCORD
GASKETS—metallic, asbestos, steel, cork and treated paper for cars, trucks, tractors, and marine, gasoline and Diesel engines. Catalog lists over 10,000 sizes and types.
RADIATORS—complete radiators for popular makes of cars. RADIATOR-CORES for all makes of cars, trucks and tractors. Catalog on request.
UNIT HEATERS—steam or hot water, vertical or horizontal type. Proven heating unit. Copper and brass construction. Quiet. For use in warehouses, factories and offices. Catalog on request.
BLAST HEATING COILS and AIR CONDITIONING COILS—all copper, spiral fin tube construction. All tubes brazed. Catalog.
REFRIGERATION AND AIR CONDITIONING—Condensers and Evaporators. Copper or steel.
LUBRICATORS—Mechanical Force Feed Lubricators for air compressors, Diesel steam engines or general industrial lubrication.
ESTABLISHED 1899
McCORD CORPORATION
DETROIT, MICH., U.S.A.
CABLE ADDRESS: McCORDRAD

Promoting Progress
with ever finer petroleum products

GULF OIL CORPORATION
General Offices Pittsburgh, Pennsylvania

Book Reviews

—he is entirely factual. In all the studies his narrative and his comments, which latter follow closely the rules and principles set forth in the synopsis, evidence his sound grasp of military history and its interpretation. Some eleven diagrams and twenty-three sketch maps, admirably simple, aid the reader's understanding of the complete text.—F. W. F. GLEASON.

HORNED DEATH. By John F. Burger. Huntington: Standard Publications, Inc. 342 pp. $6.50.

WELL fitted to be the Ordnance "book of the month" is this hair-raising account of the hunting of the African Buffalo—usually considered the most dangerous of game. A native of South Africa, Burger exhibits that easy familiarity and extreme enthusiasm for the Dark Continent which is shared only by the lifelong resident. In forty years of professional hunting, more than 1,000 buffalo have fallen to his rifle.

For his own pleasure Burger had written his adventures as they occurred. That he writes in such a pleasingly unaffected style and with such admirable clarity and succinctness is our good fortune. Just to vary the menu, the author managed to have several close squeaks with cannibals in Ubangi and with poisonous snakes throughout the continent—and the big cats provided a side dish.

The book is one of the finest printing jobs that we have ever come across, and some twenty-five well-chosen photographs illustrate an adventure story that is mighty hard to lay down.—F. W. F. GLEASON.

FORGING THE THUNDERBOLT. By Mildred Hanson Gillie. Harrisburg: The Military Service Publishing Company. 330 pp. $4.

IT is very unusual indeed to find a woman writer who can handle a military subject with any degree of insight and clearness. However, here the author has told admirably the story of the "father of the Armored Force," Maj. Gen. Adna R. Chaffee. She has nicely balanced the account of General Chaffee's monumental efforts in behalf of his rock-solid convictions on armored-vehicle development with the more comprehensive story of the Armored Force from its birth to its lusty manhood of the last war.—RICHARD FIELD.

ENDLESS HORIZONS. By Vannevar Bush. Washington: Public Affairs Press. 182 pp. $2.50.

THIS collection of seventeen essays and addresses presents a general outline of the immense range of Dr. Bush's interests. These interests include the need for patent reform, the war against disease, military research, the American tradition of opportunity, and the control of atomic energy. Dr. Bush believes that we should maintain our country strong in every way.

In this strength let us then lead, through the path of international understanding, to the organization of a world where the nations of men will find the better, happier life which man's final mastery of the energy of the atom offers, if he will but use it right. Dr. Bush is one of the great scientists of our time. One may disagree with some of his views but will find it impossible to question his motives or his intellectual honesty.—JOHN J. O'CONNOR.

THE HISTORY OF THE BIRMINGHAM GUN-BARREL PROOF HOUSE. Edited by Clive Harris. Birmingham and London: Joseph Wones, Ltd. 12 shillings, 6 pence ($2.50).

THIS record of a great English proof house during 131 years is an example of what competent and determined research can accomplish. Proofing, synonymous with progress in gunmaking, is the emphasized feature of the work; yet the behind-the-scenes notes and comment on the trade which formed so great a part of Britain's history from 1639 to 1945 add immensely to the worth of the book.—F. W. F. GLEASON.